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MERCURIALISM IN QUICKSILVER PRODUCTION IN CALIFORNIA*

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QUICKSILVER MINING AND METALLURGY IN EUROPE

QUICKSILVER has been mined in Almaden, Spain, since Roman times, and we know that mercurialism was recognized even then, for Pliny, the Younger, in writing of the diseases of slaves mentions mercurialism, plumbism, and the consumption of potters and grinders. For many centuries work in the Spanish mines had to be carried on by slaves and convicts; when free labor was introduced, it was found necessary to limit the hours of work because there was so much incapacitating illness among the men. Therefore, a tradition grew up which is still in force, that eight days of four and a half hours each, thirty-six hours in all, should constitute a month's work. The metallurgical processes in use at the present day in Almaden are very antiquated and little is done for the prevention of mercurialism among the 2,100 miners and the 400 furnace men aside from the shortening of the day (1). These mines have, in addition to the cinnabar ore, a considerable deposit of native quicksilver, which adds greatly to the danger of mining, as Lehmann noted when he visited them (2). Spain is the oldest of the quicksilver producing countries and still leads the world in production.

Italy now takes second place, for she has not only the mines at Monte Amiata in Tuscany, but, also, as a result of the Treaty of St. Germain, the very important Austrian deposits and metallurgical works at Idria in the upper Isonzo. Quicksilver has been mined here for more than four centuries (3), and the first description we have of the symptoms of chronic mercurialism was written during the first half of the sixteenth century by Andrea Mattioli of Siena, who had observed it among the miners of Idria. Some two hundred years later, in 1761, Giovanni Scopoli of Alto Isonzo wrote a remarkably clear description of mercurial tremor in Idria miners (4). There is said to be still some free quicksilver in these mines, but the metallurgi-

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cal technic has greatly improved of late and there is no longer any severe mercurialism among miners or furnace men; few cases are even moderately severe, although there are many mild cases (Teleky, quoted by Lehmann (2)). The system of alternation of work—shifting the men periodically after one month of furnace work to two months of outside work and back again—has been in force since 1897 in Idria, and as a result the cases of mercurialism fell from 122 in 1896 to five in 1908. In addition to this precautionary measure the men have a six-hour day. The institution in 1665 of this short working day, in what was then the province of Friuli, is said to be the first legislative measure of industrial hygiene known to history (Pope, quoted by Lehmann (2)).

Much less favorable are conditions in the Italian mines at Monte Amiata. Mercurialism has been notorious here ever since the first half of the sixteenth century when, under the influence of Paracelsus, mercury came into great demand for medicinal use and the roasting of cinnabar ore was undertaken. Up to that time production had consisted simply in washing free quicksilver from powdered ore. Conditions seem to have been very bad up to the middle of the nineteenth century, and although after that the metallurgical processes gradually improved, they also became more complicated, and required more oversight. If they were neglected or were entrusted to unskilled workers, an excessive contamination of the air resulted (Giglioli (5)). The furnaces now are of the Cermak-Spirek type; the ore drops down a series of inclined planes, growing hotter as it descends; the gases rise and pass to condensers where the mercury and soot and other impurities collect on the sides and bottom. The free droplets of the mercury run out through pipes; the rest is entangled in the soot, which is shoveled out, mixed with lime, and put through an Exeli press to squeeze out the mercury. There is exposure to fumes and contact during these processes, and, according to Giglioli, writing in 1909, when he visited the mines hardly any man could work on furnaces or condensers for as long as one year without becoming poisoned.

These three are the only important centers of quicksilver production outside the United States.

Chronic Mercurialism in European Mining and Reduction

The descriptions of mercurial poisoning as we get them in the textbooks are gathered chiefly from such authorities as Kussmaul, of Germany, who studied it in mirror workers, Koelsch, also of Germany, who studied it in the chemical industry, Teleky of Austria, whose observations were made chiefly in electric lamp works and felt hat works, and British, French, and Belgian authorities writing of felt hat workers. This literature shows that the clinical picture of industrial mercurialism differs decidedly in different occupations, and therefore it seems wise to confine myself, in discussing the literature in this connection, to the only detailed paper I have been able to find which deals with mercurialism in mining and reduction. This is an exhaustive report by Guido Giglioli of studies made by him at Monte Amiata, and since it is practically buried in a rare Italian publication, *Il Ramazzini* of Milan, I feel that I shall make a more valuable contribution if I abstract his findings than if I should review those of better known authors dealing with other industries.

Giglioli had opportunity to examine a force of 150 men employed in the reduc-

tion of cinnabar, and also twenty men formerly employed but at the time incapacitated from mercurial poisoning of unusual severity. Only twenty-five of these men were free from mercurialism, and of these sixteen had worked less than a year. The early stage of poisoning was characterized by loss of appetite, stomatitis of mild or moderate degree, rarely severe, dyspepsia, sometimes gastric pain and headache, and, in a few cases, slight tremor. In the next stage the most striking symptom was tremor, which was present to a marked degree in almost all of the moderately severe cases. There was also anemia and loss of weight and strength.

Inflammation of the mouth was sometimes ulcerative, accompanied by loss of teeth. In the severest form, of which there were some thirty instances, the general condition was one of pronounced cachexia. The history of these cases showed that the tremor was usually preceded by painful cramping and jerking of the muscles at night. It usually affected the hands and forearms first and most markedly, the right hand being most affected in right-handed, the left, in left-handed men. Involvement of the muscles of the legs and also of the tongue was fairly common. The miners called it "having quicksilver in the veins."

Psychic disturbances were noted in fifteen cases. Loss of memory was the commonest complaint, and was often associated with torpor. If the patient was aroused from this state, he showed great anxiety or irritability. Excitability and shyness were also noted. These men were not neurasthenic; they had no tendency to exaggerate their symptoms; on the contrary, they were timid and diffident. In one very severe case there was delirium with hallucinations, intense tremor, and clonic spasms, followed by paresis, mental torpor, and loss of memory. Paresis was noted in two other cases, but Giglioli interprets it as the pseudo-paresis of exhaustion described by Oppenheim in chorea.

Although stomatitis had occurred at some stage in almost every case, ptyalism was never marked. The musculature was often flabby and there was decided loss of strength, but no real atrophy. Marked cachexia was shown in twenty cases. Giglioli found certain symptoms which are not mentioned usually in descriptions of chronic mercurialism. These are: punctate hemorrhage under the skin, present in fourteen cases; nosebleed, mentioned in nine histories; enlargement of the liver, found in fourteen cases; and loss of the sense of smell in nine of the twenty severest cases.

Kussmaul has described tremors so extreme that not one muscle of the body seems to escape, and the clonic spasms may be so severe that the combined strength of several strong men is not sufficient to control the jerking, which throws the patient to and fro and threatens to hurl him out of bed (see Teleky (6)). Giglioli describes a number of cases with clonic spasms which are painful and may be very exhausting. They are likely to come on during sleep, appearing earlier than the tremor and sometimes lasting after it has disappeared under treatment. In other cases the spasms come on during work and last from ten to thirty minutes, completely incapacitating the man. The Italians call them "la stirarella" from the word meaning "to pull violently." They affect not only the limbs but the head. Tonic spasm is rarer, but Giglioli saw it in five cases, involving usually the arms, but sometimes the shoulders or the legs. He calls the condition toxic tetanus. Ankle clonus was present in

twelve of his cases; in thirteen cases speech was uncertain, hesitating, not typically scanning. The gait was affected in sixteen cases, and resembled that of a drunken man—rolling, with the feet placed widely apart; if told to stop suddenly, the man fell to the ground.

Quicksilver Mining and Reduction in the United States

The United States now holds the third place in the world production of quicksilver. By far the greater part of the metal comes from California, with Texas following long after. According to Ransome (7), seventeen mines were producing quicksilver in 1920 to the amount of 13,392 flasks of 75 pounds each, of which California was responsible for 9,849, Texas for 3,436. Eleven of the seventeen mines are in California, three in Texas, two in Nevada, and one in Oregon. The quantity produced in 1920 represented a striking decline in mining activity after the end of the war, for the greatest demand for quicksilver comes from the manufacturers of explosives. Fulminate of mercury, a constituent of all percussion caps and "booster charges," is the most important industrial compound of mercury. The other uses for this metal are for thermometers, barometers, and to a lessening extent vacuum pumps; for solder in dry battery manufacture; for the production of amalgam in gold and silver extraction, and for dentists' use; and for the method of gold plating known as fire gilding. Mercury is also needed for the production of acid nitrate of mercury used in preparing fur for felting, and for the production of various pharmaceutical compounds.

In spite of the importance of quicksilver mining in the United States, little has been known about actual conditions in the industry or about the occurrence of mercurialism among quicksilver miners. The only statement I have been able to find in the literature is a quotation by Kober (6) from the Eleventh United States Census Report to the effect that among the miners of New Almaden, California, about 10.44 per cent. suffer from mercurialism. It seems impossible to trace this statement to its source or to supplement it in any way, and in order to learn the actual facts at present in this field I made a visit in the summer of 1923 to the two largest quicksilver mines in California—the New Almaden in Santa Clara County and the New Idria in San Benito County. The reduction plants are close to the mines in both places, for it is much cheaper to transport the flasks of mercury than large quantities of ore, and the reduction processes do not require an elaborate equipment. It was not a favorable time for an investigation of mercurialism, for there had been a prolonged slack season during which men had to seek other employment, and the mines had opened again with much reduced forces. The men who were working were either new hands for the unskilled jobs or seasoned men who represented the survival of the fittest.

The quicksilver mines of California are not deep, few running down as much as 500 feet below the outcrops. Ninety-five per cent. of all the output is cinnabar, HgS, and a black amorphous variety known as metacinnabarite. The other compounds of mercury which occur, although in small quantity, in American mines are the selenide, or Tiemannite; the monochloride; the iodide, or Coccinite; and the telluride, or Coloradoite. All the ores are imbedded in quartz-bearing rock except in the New Almaden mines. The Idria ore has large quantities of iron oxide and some manga-

dioxide, but none of the ores carries lead or arsenic, and the problem of industrial disease resolves itself into the simple question of mercurialism.

In California mines native quicksilver is found in droplets in the serpentine area. During the war these mines, in which, as the men say, "the silver runs free," were worked because of the great demand for quicksilver to make mercury fulminate, and the countryside is still full of tales of the experiences in them. I talked with a man who worked in 1917 in the Socrates mine in Sonoma County, where the silver runs free and the temperature is over 90°. He worked only two weeks. First he noticed that his teeth were so sore that he could not chew solid food. Then his mouth and lips became swollen and inflamed. There was a profuse flow of saliva, and he became very nervous, suffered from cramps in his legs and arms at night, and had to quit the mine and take a job out in the open where, after two or three months, he was quite well again. Dr. F. S. Ryan, of San Jose, told me that he knew of miners, Cornishmen, working in very hot shafts, who not only became poisoned themselves but carried home so much mercury in their clothes that their wives, through washing the clothes, became salivated.

These are the richest mines, where the silver runs free, but even under the urge of the war it was impossible to work them. Drilling for the charge produces a fine dust laden with tiny droplets of mercury, which quickly volatilizes in the heat, and the quicksilver released by blasting coalesces into large drops, which run down and collect under the rock and dust and must be dug out and scooped up. Even working the men in two-hour shifts with two hours off, providing shower baths and hot sulphur baths, and posting signs urging them not to exert themselves too much, was not enough to protect them against poisoning, and the mines had to close down. None of them is worked at present.

Work with cinnabar ore is harmless unless, according to the universal testimony of experienced men, the miner rolls his own cigarettes. This habit, so prevalent among the Spanish miners, is looked upon as dangerous, for fine cinnabar dust gets mixed with the tobacco and when the cigarette is lighted the heat decomposes it and releases the mercury in vapor form. It requires a heat of less than 400° C. to decompose finely divided HgS. I did not meet any miner who had suffered from mercurialism when working with cinnabar ore who did not attribute it to rolling cigarettes.

The metallurgy of cinnabar reduction is very simple, for it begins at as low a temperature as 338° C. to 420° C. (Hofman (8)) to decompose into metallic mercury and SO_2. No sampling or assaying is done. The ore is sorted by hand, crushed, screened, dried, and roasted, either in revolving kilns or in a Herreshoff furnace automatically fed and mechanically rabbled. Roasting takes place with an abundant air supply to oxidize the sulphur, but since HgO dissociates at 400° C. the roasting of HgS results in the production of the metal, not the oxide.

A draft of air carries the mercury vapor, dust, and carbonaceous "soot" or "stupp" to condensers; a Cottrell precipitator may be introduced between the furnace and the condenser to get rid of excessive dust. Condensation takes place in pipes or chambers which may be made of iron if no water is used, but if a cooling spray of water is used, sulphuric acid will be formed from the SO_2 and the condenser must be made of tiles or wood. Quicksilver is said to penetrate all these substances, working its

way through the lining of the furnace, iron pipes, fire brick, and terra cotta, and, of course, so impregnating the wooden condenser that it must be torn down sooner or later and put through the furnace. At the time of my visit to New Almaden, the men were recovering mercury from the ground 30 feet under an old furnace by cradling and washing out the dirt as in placer mining.

The mercury which condenses flows out through a small pipe to a reservoir, but a good deal is still held in the soot and must be recovered. Cleaning the soot out of the condensers takes place about once a week. Sometimes they are washed out with a hose, and if the installation is built on a slope, the water flows down to the settling tank and no one need enter the condensers. Yet, even in work of this sort, I was told by the man in charge that the men would get salivated unless they took a shower bath and a mouth wash at the end of the day and changed their clothes. The mud which collects in the settling tank contains mercury in the form of quicksilver droplets and of "flour"—that is, mercury in very fine subdivision which cannot be made to coalesce without further treatment. This mud may be dried, mixed with lime, and sent back to the furnace, or it may be treated first on steam tables in order to recover the droplets of quicksilver. The mixture of mud and lime is placed on a sloping steam table and is raked back and forth till the droplets flow together and run down to the lowest corner and through a pipe to the quicksilver kettle. After this treatment the residue which still contains quicksilver is heated in a retort and the last traces of mercury are removed.

Volatilized mercury is encountered in furnace work, in cleaning out the condensers, especially by hand, in the work at the steam tables which the men consider especially bad, and in the work at the retorts.

Chronic Mercurialism in California

The men in the California field[1] are all familiar with the symptoms of mercurialism and most of them have at some time suffered from an attack of poisoning, usually when they were employed on the old type Scott furnace, which seems to have leaked badly at the charge and discharge, so that practically every man was poisoned sooner or later. I saw only eight furnace men with characteristic tremor, and only one with marked gingivitis, but I heard many histories of former attacks. It is confusing to hear the men talk of salivation because they use that word to cover mercurial poisoning of any kind and have no idea that it has anything to do with an increased flow of saliva, a symptom which I found fairly rare, as did Giglioli.

In a typical case with a slow onset the first thing noted is often a bad taste in the mouth, variously described as metallic, or coppery, or sweetish. There is soreness of the teeth on pressure, and this increases till it is painful to eat solid food. The gums may swell, the teeth become loosened, though they rarely come out, but ptyalism is not marked and may not be noticed at all. In the more slowly developing cases, such as occur in reduction plants under present conditions, the lesions in the mouth are usually slight and may not be present at all, and tremor is the most conspicuous symptom. Some men with marked tremor told me that they had never had more than a slight soreness of the teeth and a disagreeable taste in the mouth. Others had had no inflammation of the

[1]There were ninety-five men employed at the time in New Idria, and thirty-five in New Alma

mouth at all; they had noticed only tremor, headache, insomnia, and dyspepsia.

A furnace man employed in such work for seven years gave a history of two attacks of mercurialism. The first symptom that he noticed was a metallic taste, "like iron;" then his mouth became sore, but there was no salivation. His appetite was lost, and he had an attack of gastric pains with diarrhea lasting a few days and followed by tremor which lasted for several weeks. After both attacks he noticed that his hair fell out.[2] Another furnace man had been on the job only one month when I saw him, but he had worked before from 1909 to 1918 and had had several attacks of poisoning. When I saw him, he had already a marked intention tremor of the fingers and hands, which was very typical. He told me that if he chewed tobacco he never suffered from inflamed gums, but if he did not, his mouth would grow sore and his teeth loosen. When he had a bad attack, as, for instance, after a clean-up job, or before the war when he was on a Scott furnace, his mouth would be so swollen that he could hardly speak, his breath was terribly foul, and he suffered from headache and intensification of his tremor from which he is never quite free while on furnace work. The last attack of this sort occurred less than a month before I saw him, on the second day after he started work on the furnace.

These are quite typical cases, but there is a much severer form which is seen in men exposed to larger doses of mercury, as in mining free quicksilver, in tearing down old condensers or old furnaces, in repairing furnaces, or in other jobs involving unusual exposure to mercury. For instance, Dr. F. S. Ryan of San Jose, the physician in charge of the New Almaden mines and reduction works, gave me histories of acute, severe mercurial poisoning such as is seldom seen in industry. Five or six cases developed under his observation in men who were working up the quicksilver-impregnated earth under some old furnaces which had been torn down, and recovering the metal. These men had swelling of the mouth and lips and ulceration of the gums, with loosened teeth, sometimes salivation, painful cramps in the limbs, especially at night, severe colicky pains, and diarrhea with blood in the stools. There was no tremor during the acute stages, but it came on later and lasted for weeks or even months. Several histories of this sort were given me by men who had worked on Scott furnaces in former years.

Mercurial psychosis is a well-recognized condition in the California quicksilver field. A change of disposition occurs which shows itself either in an increasing unreasonableness, "crankiness," making work with others impossible, or perhaps in increasing sensitiveness and readiness to take offense at trifles, or in dulness and torpor or somnolence. A foreman on furnaces had to be discharged because he began to talk to himself and would not take orders from anyone. A young man belonging to a small development company was badly poisoned, with salivation and loss of most of his teeth, and gradually became dull and apathetic to such a degree that at a meeting of crucial importance to the company, involving all his future plans, he fell asleep in his chair. He recovered completely, however, when he was no longer exposed to mercury.

The most severe case of mercurialism of which I heard during this investigation was characterized by clonic spasms

[2] This man and several others told me that the gold fillings in their teeth turned gray.

like those described by Kussmaul and by Giglioli. Dr. Ryan of San Jose gave me this history, and I had an opportunity to meet the man and hear his story and that of his fellow-workmen. He is a California Spaniard and evidently unusually susceptible to mercury, for he had several attacks of acute poisoning while mining cinnabar. He was not a heavy drinker, but did drink native California wine in moderation. His attacks would begin with a queer sweetish taste in the mouth and then colicky pains and diarrhea, but there was never any inflammation of the gums or salivation, nor has he lost a tooth. The most serious symptom always was tremor. From the mines he went to work on a Scott furnace where the fumes were very bad, and during this time the tremor was practically constant and often very troublesome, especially if he were excited, when it would be impossible for him to feed himself.

In spite of the doctor's warning he continued at work on the furnaces and then, one afternoon at about 3 o'clock in his home in the mining camp, he suddenly began to have violent clonic spasms of the right leg which, as he described it, "began to work up and down like a pile driver." His friends, feeling sure that the only way to save him was to stop the jerking, tried to hold him down by force but found that he could actually lift a heavy man who put all his weight on the leg. Dr. Ryan saw him about three hours later. The right thigh was drawn up on the abdomen, the leg flexed on the thigh and then forcibly extended, the jerking being rhythmic and regular, about sixty times a minute, without any variation and with extreme violence. Morphine had no effect on the spasm, nor did it make the patient sleep, though he did become drowsy. There was no change in his condition under treatment with hot packs, ice to the head, and purging; indeed, the following morning a supinator spasm of the right forearm developed. There were no cerebral symptoms except the obstinate insomnia. Chloroform was then tried, but the spasms did not cease completely till the stage of surgical anesthesia was reached, and they returned as it passed off.

Thirty-six hours after the onset sleep was secured by the administration of chloral and the jerking diminished in violence and gradually died down under purging, sweating, and chloral, to disappear completely on the seventh day. The patient's exhaustion was extreme, increased by his inability to take any but liquid food and this with difficulty because he could not keep still long enough to swallow much. He was discharged from the hospital emaciated and weak, and for a year after he was too weak to work and was a prey to insomnia, bad dreams, headache, depression and irritability. Nevertheless, he went back to the furnaces the following year and worked for six or eight months when his increasing tremor compelled him to give up. I saw him at the works where he was employed as a teamster, and he told me he had never recovered his former health. He is always nervous, excitable, and prone to lose his temper over mere trifles, a statement which was heartily endorsed by the bystanders. Just recently he had to undergo an operation for gastric ulcer and under the excitement of preparing for it he developed his old tremor.

These men have very definite ideas as to the proper way to prevent poisoning. They all know that any alcoholic drink, even native California wine, increases both tremor and psychic symptoms. Cigarette smoking is regarded as dangerous, and old hands always advise the new men to give it up and chew tobacco

instead, believing, as do most workers in dangerous dusts, that constant spitting gets rid of much of the inhaled poison. They say that if a man takes a shower bath, rinses his mouth, and puts on fresh clothing at the end of his shift he can protect himself against an attack. Experience has taught them that wearing a dirty suit or even a dirty hat is a risk. There is no difficulty in getting the miners to use shower baths, for they never wear their working clothes home; furnace men often do, however, and it is much harder to get them to bathe and leave their working clothes at the plant. The best treatment for an attack of poisoning is said to be getting out into the open or into the mines and working hard to "sweat the poison out."

Giglioli says there is no acquired tolerance to mercury, nor did I obtain evidence of any. The reason why old hands can keep on for years is that they have learned how to protect themselves. Any imprudence on their part is followed by soreness of the mouth or tremor of the hands.

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SEASONAL FLUCTUATIONS IN FREQUENCY OF INDUSTRIAL ACCIDENTS*

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THROUGH the kindness of a number of state industrial boards, whose co-operation is hereby gratefully acknowledged, the authors of this paper were enabled to study the monthly fluctuations of industrial accidents over a period of several years. The industrial boards of Indiana, Illinois, Massachusetts, Maryland, Minnesota, and Ohio supplied them with tabulations for the years 1918, 1919, 1920, and 1921 which gave the total number of accidents in their respective states distributed by months, and from the data—covering 1,892,957 accidents—thus secured, the average number of daily accidents each month in these six states was computed for each of the four years mentioned by dividing the total number of accidents in the month by the number of working days. For example, in January, 1918, the Indiana Industrial Board reported 2,746 accidents. Since there were twenty-six working days in the month, the average number of accidents for each working day was 105. The sum of these averages for all of the states constitutes the number plotted against a given month in Figure 1.

Some of the years (especially 1919) for which data are presented were periods of industrial expansion; others (especially 1921) were periods of depression. Nevertheless, a high degree of uniformity is shown in Figure 1. A steady rise from a low point in April to a peak in July and August followed by a steady drop to a low point in November is characteristic of all four curves. The period from November to April appears to be one of marked fluctuations.

FIG. 1.—Average number of daily accidents per month in six states during the years 1918, 1919, 1920, and 1921.

In seeking an explanation of the rise which culminates in July and August, one is tempted to speculate that perhaps high temperature is a prominent factor. The exact weather conditions in the localities from which the figures were gathered during the years covered by the investigation are, of course, not known. It is fair to assume, however, that since the data were all gathered in about the same latitude, the winter months were cold and the summer months hot. Osborne and Vernon (1) found that when the temperature inside British munition factories was 75° F. or higher, the frequency of accidents was 23 per cent. greater than when the temperature was from 65° to 69° F. Belief in a causal relation is still fur-

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the confirmed by the findings of Dexter (2), which show that other phenomena akin to accidents, such as the number of New York policemen on the sick-list, the death rate by assault, and the number of misdemeanors in a penitentiary, occur more frequently in the hot months. Chaney and Hanna (3), also, found that in the machine building industry the number of accidents in August exceeded that in any other month. It may be that other component weather conditions, such as barometric pressure and humidity, also influence the curve of industrial accidents, but no conclusions on this point can be drawn from the data available.

Another characteristic of the distribution of industrial accidents in the four years under consideration is that the number of accidents during the last six months is greater than during the first six months. The total of the averages presented in Figure 1 for the first half of the four years is 35,180; the total for the second half, 38,322—an increase of almost 10 per cent. This may possibly be accounted for by greater industrial activity during the latter part of the year (4). In order to verify this hypothesis, one would need some index of industrial ebb and flow in the states examined during the period covered. Such an index was not at hand. The phenomenon appears, however, in quite a number of measures of business activity. Babson's Statistical Tables and Charts (see, for example, the issue of Feb. 27, 1923) show a uniform increase during the latter half year in bank statements, volume of foreign trade, production of pig iron and railroad earnings per mile. If industrial activity in general increases during the latter part of the year, there is likely to be an increase in the number of new employees and these, as has been shown in a previous study (5) exert a powerful influence upon the number of accidents.

It is readily acknowledged that the method of investigation employed in this study—that of massed statistics—may tend to hide certain subtle factors. It is also acknowledged that the number of accidents should be computed, as Chaney recommends, on the basis of exposure of each employee per hour worked. This refinement could not be employed here, but it is hoped that although the lack of it may have obscured certain minute features, still the large mass of data used may have served to bring out the gross fluctuations from month to month; and that whatever factors are general and present in a variety of conditions may have been accentuated by the very fact of numbers. The causes of these fluctuations in accidents are undoubtedly too numerous to be listed here. There is evidence, however, pointing to the influence of temperature, particularly high temperature; and to the influence of industrial activity, one manifestation of which may be a large number of new employees.

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SEASONAL FLUCTUATIONS IN FREQUENCY OF INDUSTRIAL ACCIDENTS*

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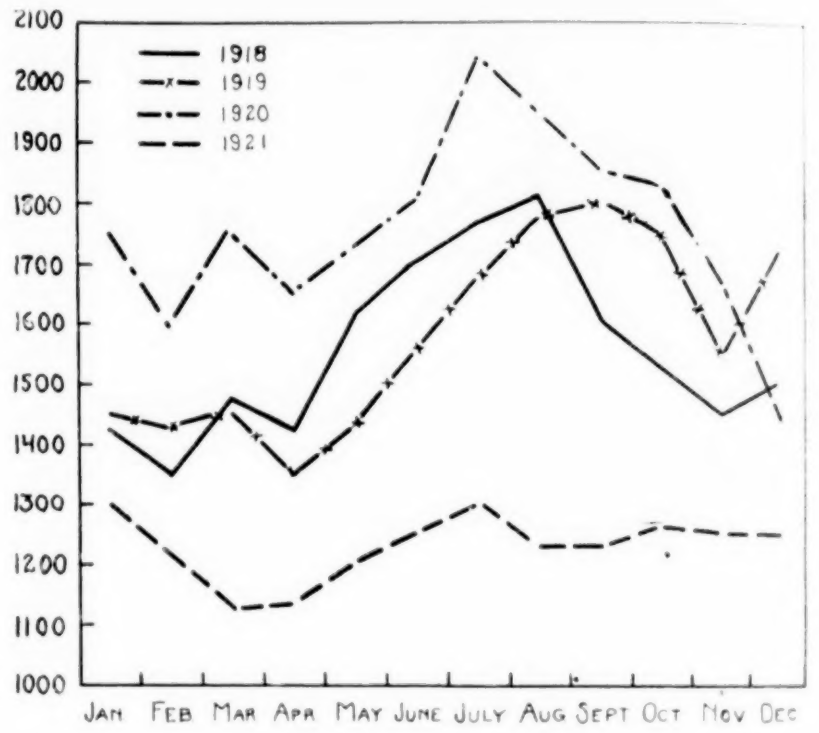
THROUGH the kindness of a number of state industrial boards, whose co-operation is hereby gratefully acknowledged, the authors of this paper were enabled to study the monthly fluctuations of industrial accidents over a period of several years. The industrial boards of Indiana, Illinois, Massachusetts, Maryland, Minnesota, and Ohio supplied them with tabulations for the years 1918, 1919, 1920, and 1921 which gave the total number of accidents in their respective states distributed by months, and from the data—covering 1,892,957 accidents—thus secured, the average number of daily accidents each month in these six states was computed for each of the four years mentioned by dividing the total number of accidents in the month by the number of working days. For example, in January, 1918, the Indiana Industrial Board reported 2,746 accidents. Since there were twenty-six working days in the month, the average number of accidents for each working day was 105. The sum of these averages for all of the states constitutes the number plotted against a given month in Figure 1.

Some of the years (especially 1919) for which data are presented were periods of industrial expansion; others (especially 1921) were periods of depression. Nevertheless, a high degree of uniformity is shown in Figure 1. A steady rise from a low point in April to a peak in July and August followed by a steady drop to a low point in November is characteristic of all four curves. The period from November to April appears to be one of marked fluctuations.



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ABSTRACT OF REPORT ON BAKERS' ITCH*

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INTRODUCTION

THE present inquiry was undertaken in response to a communication received by the Ministry of Health from the General Secretary of the Amalgamated Union of Operative Bakers, Confectioners and Allied Workers, in which attention was drawn to the occurrence of a comparatively large number of cases of dermatitis, commonly known as "bakers' itch." The points upon which attention has been concentrated are:

1. Has there, indeed, been an increase of the condition known as bakers' itch during and since the war?

2. If so, what are the reasons for such an increase?

3. The nature of the conditions giving rise to individual cases of bakers' itch.

4. The clinical characteristics of the condition.

5. Methods of prevention that might usefully be adopted.

6. Does it appear that the existing rules and regulations relating either to Bakeries (Public Health Acts and Factory Acts) or to the Baking Trade (Master and Servant Act) require alteration or addition?

The first step taken in the prosecution of the inquiry was to learn from the General Secretary of the Bakers' Union from what parts of the country cases had been reported to him. Attention was then focused on these particular districts. Some of them were visited and wherever possible patients were examined and interrogated; district secretaries of the Bakers' Union were instructed by their General Secretary to report all cases of bakers' itch coming to their knowledge, and questionnaire forms were sent from the Ministry to all patients so notified. Most of the evidence has been sought and obtained through the agency of the Amalgamated Union of Operative Bakers, Confectioners and Allied Workers. Not all bakers, however, are operative bakers; indeed, these journeymen bakers, as they are also termed, are in the minority as compared with the master bakers in the ratio of 36,000 to 40,000. Again, not all operative bakers are members of the trade union which is specially interested in this inquiry; the actual membership according to the General Secretary is 16,000. Since evidence derived from only one trade union of operative bakers, therefore, would be partial, attempts were made to collect information through other sources and on independent lines. Thus, the Master Bakers' Associations were asked to give their views as to the prevalence of bakers' itch among their associates; the caterers and more important bakers in London were also asked to co-operate. Then, too, it was considered germane to the inquiry to discover, if possible, whether the millers throughout the country were at all affected. Another important approach to the question was naturally from the purely medical side, and every known skin clinic was canvassed for information.

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What Is Bakers' Itch?

Many circumstances and many creatures may be severally concerned with the production of a "teasing irritation of the skin" in human subjects, and a number of specially designated "itches" exist in addition to that caused by the *Sarcoptes scabiei* which enjoys pride of place with the title of "The Itch."

The majority of itches which have been described in this and other temperate countries are connected with certain trades or are dependent upon the continued use of various substances (*e.g.*, tar products, lime, sugar, drugs, etc.), not necessarily irritating in normal circumstances. Among occupational dermatoses in which pruritus is a prominent symptom may be mentioned grocers' itch, dry salters' itch, basket makers' itch, and plasterers' itch; in this category may also be included the subject under review—bakers' itch.

These occupational affections of the skin are characterized by their grouping, situation, mode of appearance, spread and evolution. The inflammation is sharply outlined as a rule and is usually confined to the hands, particularly the dorsum; when the irritant is in the form of dust, a much more general distribution, including covered parts of the body, may be expected. Gardiner (1) points out the frequency with which seborrhea, hyperidrosis, and precedent skin disease are mentioned in the previous histories of patients suffering from trade dermatoses.

Prosser White also emphasizes the importance of bearing in mind the "possible co-existence of other skin diseases." In particular he says: "Two conditions which must be carefully looked for and excluded from occupational dermatoses are the three types of seborrhoeic dermatitis—the eczematous, the lichenoid and the psoriasis form; and the erythematous, papular, vesicular and pustular eczemas."

An important feature in the behavior of trade dermatoses is the readiness with which they disappear when the cause is removed, and their proneness to relapse when the patient cannot permanently abstain from his trade.

Exclusive references to bakers' itch are rare in the literature of dermatology. The condition, according to Prosser White, was first described by Willan, in 1817, who called it *psoriasis diffusa*. Much of the subsequent literature relating to the subject is concerned with the effect of sugar on persons brought into contact with this substance, but I have not been able to find much written information relating to the action of flour or dough on bakers. The subject receives but scant attention in modern textbooks on skin diseases, and it may be well, therefore, to quote here what has been said on the subject by three eminent authorities.

Sequeira (2):

> . . . Grocers, confectioners and others who handle sugar suffer from an acute form of dermatitis which often becomes pustular. The eruption is usually irritable—"Sugar-bakers' itch."

Stelwagon (3, p. 449):

> Bakers (and grocers, confectioners, sugar refiners, fruit preservers) may present acute or subacute dermatitis or eczema . . . usually of hands, sometimes involving the face and other parts; attributed to the heat, moisture, dough and the saccharine solution—with the possibility that a flour mite may occasionally be etiologic or contributory. Confectioners occasionally shew a similar eruption and sometimes mixed with impetiginous lesions, or the later eruption only; it may be so extensive in sugar refiners and molasses stirrers as to resemble a pustular scabies with exceptionally furunculoid development.

Prosser White (4, pp. 170-171):

> Bakers, pastry-cooks and confectioners are frequently the victims of skin affections, the back of the hand being a common site of

trouble, as the result of the constant kneading of the dough, possibly made worse by the heat of the oven. . . . Dry and scaly patches, of more or less circular shape, are its usual characters.

Bakers' itch does not, under this designation, figure prominently in official records and documents. It is not specifically mentioned in the rules and regulations drawn up under the Workmen's Compensation Acts. Formerly, the condition was included in the group of diseases characterized by "eczematous ulceration of the skin produced by dust or liquids. . . ." Then under Statutory Order No. 286 of 1916 the description ran "Ulceration of the skin, or any dermatitis produced by dust or liquids. . . ." Finally, under Order No. 287 of 1918, this description was divided and bakers' itch was included under "11 (*a*) Dermatitis produced by dust or liquids." In none of these Orders is any description of process mentioned, and, incidentally, it may be questioned whether the majority of cases of bakers' itch are indeed "produced by dust or liquids." The Annual Reports of the Chief Inspector under the Workshop and Factory Acts from 1914 to 1920 contain no reference to bakers' itch.

In Bulletin No. 306 issued by the United States Bureau of Labor Statistics (5) is given a list of "Occupation Hazards and Diagnostic Signs," and it is interesting to note that baking is not mentioned among such hazards though confectionery and sugar-refining industries are included. Bakers, however, are scheduled as being subject to sudden variations of temperature, organic dust irritation, and carbon monoxide poisoning, and flour workers are also considered as being subject to irritation from dust.

Information Derived through the Various Means Adopted in the Inquiry

Nature and Extent of the Response Elicited

The General Secretary of the Bakers' Union, from reports received through the district secretaries, showed that the majority of cases had occurred in the Liverpool and South Wales Districts, while next in order of importance came the Durham and Northumberland Districts. Later, during the inquiry, some interesting statistics were supplied regarding the baking trade generally and the trade union elements. Of seventeen district secretaries who were circularized ten replied. These officials were asked to give statistics for their districts relating to the occurrence of cases of bakers' itch and the amount of sick pay given to members of the union suffering from the complaint. In the matter of figures these reports were for the most part barren, but each reporter availed himself of the opportunity for recording some general observations.

The districts into which, for the purposes of the Amalgamated Union of Operative Bakers, Confectioners and Allied Workers, England and Wales are divided comprise:

Birmingham District		Birkenhead District	
Liverpool	"	Midland	"
South of England	"	Warrington	"
		South Eastern	"
Newcastle and Durham	"	Rochdale	"
		South Wales	"
Northern	"	Nottingham	"
Manchester	"	Preston	"
Staffordshire	"	Devon and Cornwall	"
Bristol	"		

The above is the order in which these districts are enumerated in *The Journeymen Bakers' Magazine* which is the

official organ of the Operative Bakers' Union.[1]

Replies were received from three out of the four Master Bakers' Associations that were addressed—namely, The Scottish Association of Master Bakers, The National Association of Master Bakers, Confectioners and Caterers, and another approved society of bakers and confectioners. The questions and answers in the case of these associations had reference only to the prevalence of bakers' itch. Eighty per cent. of the caterers and high class bakeries in London that were circularized replied. To the managers of these establishments the condition of bakers' itch appeared generally to be unknown. The millers of England and Wales were no less responsive, and answers were received from seventy-one firms out of about eighty-six that were approached. No evidence of any similar form of dermatitis among milling operatives was forthcoming.

Concerning patients said to be affected with bakers' itch, ninety-eight forms (Q) have been collected. In general these questionnaires were filled in by the patients themselves, while in other instances the details were supplied by the branch secretaries of the Union of Operative Bakers. The same forms, however, were used for master bakers and for non-union operatives.

Medical evidence concerning the prevalence of bakers' itch was solicited by a circular letter sent to 100 medical institutions in England. These included 14 general hospitals, 5 hospitals for the diseases of the skin, and 32 infirmaries in London; and 44 general hospitals, together with 4 skin hospitals, in the more important provincial areas. Replies of varying interest were received in 61 instances, and, with one notable exception, the evidence was chiefly negative in character. These direct inquiries were supplemented by informal discussions and correspondence with various dermatological specialists, Medical Officers of Health, and certifying surgeons under the Factory Acts.

Analysis of Information Received

Prevalence.—In his first letter, which originated the inquiry, the General Secretary of the Operative Bakers' Union referred to "the comparatively large number of cases of Dermatitis, or, as it is commonly called, Bakers' Itch" and in a subsequent communication with the Ministry dated January 24, 1922, spoke of "the alarming increase in the cases of Dermatitis among Operative Bakers."

The great majority of district secretaries, also, stated that they considered that there had been an increase in the number of cases during recent years, but as a rule no figures, actual or approximate, were given in support of this contention.

In a very few districts, notably Liverpool and South Wales, inquiries among bakers themselves have elicited the opinion, "There is a lot about." On the other hand, a very common answer to casual inquiries made in the course of my movements about the country generally has been, "Never heard of the complaint." An answer in this sense, too, occurs very frequently among the replies received from leading caterers and bakers in London.

The general consensus of medical opinion, as gauged by formal inquiries at various skin clinics and by informal discussions with individual general

[1] The word "district" when used in this report will signify one of the trade union districts enumerated above, and the Amalgamated Union of Operative Bakers, Confectioners and Allied Workers will be referred to as the Operative Bakers' Union or O. B. U.

TABLE 1.—DISTRICTS AND TOWNS REPORTING CASES OF DERMATITIS AMONG BAKERS

District or Town	Number of Cases	Remarks
Liverpool and District	37 (all recent)	These are cases of dermatitis among trade union bakers from whom Form Q has been returned duly filled in.
Same	48 (May, 1922)	This number includes about 20 cases of those enumerated above, together with cases among master bakers and female employees. The record is the result of an inquiry by Dr. Mussen, Assistant Medical Officer of Health, Liverpool.
Same	197 (1910-1921)	These figures are supplied by Dr. McCormick Mitchell,[1] and represent the number of cases that have come under his notice during the time stated; they include a certain proportion of the cases included in the two items above.
Same	4 (per annum)	Dr. Barendt.[2]
Birkenhead District	27 (since 1913)	Figures supplied by District Secretary, O. B. U.
South Wales (chiefly Cardiff and Newport and contiguous places)	11	These represent cases about which particulars were sent in on form Q or collected personally by the author. The District Secretary stated that in his opinion there had been over 100 cases in his area during the past 4 or 5 years.
Durham and Northumberland (chiefly Newcastle-on-Tyne)	15 (1921-1922)	All reported with personal details by the District Secretary, O. B. U. Altogether, the Secretary considers there have been 40 to 50 cases since 1918.
Manchester	6 (1921-1922)	Personal details supplied by O. B. U.
Same	20 during last 4 years	Dr. R. Gibson, Manchester, and Salford Skin Hospital.
Same	"several cases"	Dr. W. Dyson, Manchester Royal Infirmary.
Preston	1	Reported by O. B. U.
Bristol	5 (1921-1922)	Reported by Medical Officer of Health, and forms filled in for each case by patients.
Same	15 (1910-1921)	Dr. Kenneth Wills, General Hospital, Bristol.

[1] Physician, Liverpool Skin and Cancer Hospital.
[2] Physician, St. George's Hospital for Diseases of the Skin, Liverpool.

practitioners, is that cases of bakers' itch are seen only very infrequently and have not become more common in recent years. Dr. Sequeira, to quote an eminent authority, writes: "I am surprised to learn that there is an 'alarming increase in the cases of dermatitis among operative bakers.' I have directed special attention for a long time to skin affections resulting from various professions and occupations, and I am convinced that should such conditions be widely prevalent I should have records of numerous cases in my department at the London Hospital." Dr. H. G. Adamson of St. Bartholomew's Hospital says, "It would be a wild exaggeration to say that he has seen no bakers' dermatitis during or since the War." Dr. Arthur Whitfield, in an interesting note, states that he has seen no bakers' dermatitis within the last six years and concludes by saying, "Bakers' dermatitis is and has been a very rare disease in my out-

TABLE 1.—*Continued*

District or Town	Number of Cases	Remarks
London	1 (1922)	Reported by O. B. U.
Same	4 (1922)	Reported by Hospital Authorities. Also: St. John's Hospital, 20-30 (including old cases) patients seen annually. St. George's Hospital, 3 cases in 17 years. University College Hospital, 2 or 3 cases in last 3 years. Prince of Wales Hospital, Tottenham, 1 case in 1919.
Sheffield	4-6 (per annum)	Dr. Rupert Hallam, Royal Infirmary.
Bradford	4 (in 2 months)	In one practice; communicated by Dr. Bridge (Home Office).
Leeds	1 or 2 (per annum)	Dr. R. A. Veale, London General Infirmary.
Nottingham	3	Notified by District Secretary, O. B. U. The circumstances of 2 of these cases specially investigated by Dr. Boobbyer.
Birmingham	About 12 (1914-1921)	Estimated by District Secretary, O. B. U.
Warrington	3 (1922)	Known to District Secretary, O. B. U.
Rochdale	3 (1921-1922)	Same.
Fenton	3 (1921)	Two cases reported by Dr. Arlidge; 1 by O. B. U.
Shrewsbury	1 (1922)	Reported by O. B. U.
Ferryside	1 (1922)	Same.
Devon and Cornwall District	1	Same.

patient department."

In strange isolation stands the evidence of Dr. H. McCormick Mitchell of the Liverpool Cancer and Skin Hospital who reports that he has had considerable experience of the condition, and supplies the following record of his cases.

Period	*Number of Cases Treated*
1910-1913	18
1914-1918	81
1919-1921	98

A pale reflection of this state of things is seen in the case of Manchester; for the rest, however, no medical evidence of any striking prevalence of bakers' itch nor of any "alarming increase" in this condition since the war has been forthcoming.

The number of cases about which definite particulars have been received by means of the questionnaires is ninety-eight.

Distribution.—Information regarding cases of dermatitis among bakers, derived from all sources, shows that during recent years such a condition has been noted in the districts and towns in Table 1. Liverpool and its immediate neighborhood is apparently much more affected than other districts from which

cases have been reported. Local hearsay in South Wales has it that there are, or have been, a great number of cases in and around Cardiff, Newport, Swansea and other places, but this has not been borne out by the figures supplied. The Durham and Northumberland area is also regarded as a focus by the Operative Bakers' Union. With regard to Bristol the evidence comes mainly from medical sources and refers to severe hospital cases. The condition (bakers' itch) is reported mainly from thickly populated industrial districts and the towns which are chiefly concerned are all adjacent to sea or river. In this connection, the following figures (supplied by the General Secretary) are of interest as indicating a certain correlation between the prevalence of the disease and the degree of local trade union organization.

The Lancashire Districts of Liverpool, Manchester, Preston, Warrington and Rochdale are organised at least 80 per cent. (*i.e.*, 80 per cent. of the operative bakers in such districts are members of the Amalgamated Union of Operative Bakers, Confectioners and Allied Workers) and possibly rather more in some of the towns. The Newcastle and Durham area shows 75 per cent. The Yorkshire District, the South Wales District and the Birmingham District are about 65 per cent. The Midland District from Leicester, the Potteries District and the Nottingham District are from 66 to 70 per cent. The Eastern Counties, the South of England and Devon and Cornwall are 50 per cent. The weakest organised District is London and the Home Counties, which is not more than 33 per cent.

The pre-eminence of Liverpool in Table 1 does not rest alone on the highly organized condition of its operative bakers, nor on the fervent activities of the local district secretary; the health authorities by their investigations have materially strengthened the contention of the union as far as this area is concerned. From an independent and professional source, too, comes evidence that the condition is comparatively prevalent in Liverpool; it should be noticed, however, that another local specialist in skin diseases finds nothing unusual about the incidence of bakers' itch in this city.

For some reason or reasons, therefore, the condition known as bakers' itch has attracted more attention in Liverpool than in any other place. South Wales is also regarded by the trade union officials as a much affected area but I could find, in Cardiff, at all events, no medical confirmation of this.

The Years of Incidence.—The statement by the General Secretary of the Operative Bakers' Union that "the increase in dermatitis in our Trade did undoubtedly begin during the days of the War" has been corroborated generally by the various district officials of the union, but not many exact details have been forthcoming. In one instance a district secretary reported that there had been no increase in his area during the last nine years. On the medical side, also, exact figures are rarely given, but in this instance the great majority of hospital authorities who reported were unanimous that there had been no increase of late years in the number of patients with bakers' itch applying for hospital treatment. The exceptions were Liverpool and Manchester.

According to such statistics as are available it would seem that most of the cases of dermatitis among bakers have been reported during the years after the war; but for various reasons these statistics do not provide altogether satisfactory evidence.

Seasonal Incidence.—In the opinion of most of the district secretaries who were questioned, no time of the year is specially marked by the incidence of dermatitis among bakers. The district sec-

retary at Warrington, however, stated that the condition was most prevalent during the summer; while in the Northern District February to August was stated to be the chief season for the complaint. An analysis of those personal reports which refer to the dates of incidence yields the following results:

	No. of Cases	*Total*
January	11	
February	9	
March	5	
	—	25
April	11	
May	8	
June	8	
	—	27
July	13	
August	3	
September	3	
	—	19
October	5	
November	5	
December	2	
	—	12

These figures, for what they are worth, bear out the general conclusion of the union officials that the condition of bakers' itch is not associated with any special time of the year. At Bristol Dr. Kenneth Wills finds that twelve out of fifteen cases seen by him since 1910 occurred during the winter months.

Environment.—Most of the cases of bakers' itch reported by the Bakers' Union were from big cities and industrial centers, and, speaking generally, the congested conditions associated with such towns as Liverpool, Newcastle-on-Tyne, Cardiff and others, appeared to have a bearing on its incidence. Local observations also disclosed in some of these towns that the shops and houses where the patients worked and lived were usually found in the poorer and more densely populated portions of the city, while many of the bakeries were not satisfactory as such.

It was, moreover, exceptionally rare to find a case of dermatitis in the larger and more modern establishments of those towns in which the condition was well known. A thorough inspection of persons and processes was carried out in a large bakery at Bootle. Although the buildings are old a great deal of care and thought is given to the conditions under which the employees work. No case of dermatitis was found among the workers within this bakery—not even among the girls engaged in the confectionery department—and the manager stated that the condition was practically unknown; this statement was confirmed later by the lady welfare worker to the establishment.

With regard to London, the general opinion among leading caterers and bakers is that dermatitis is unknown among the employees at well-equipped establishments. Two managers out of fifty replied that they each had seen one case, but a large majority of the remainder reported that they were unaware that such a condition as bakers' itch existed.

Social Factors.—Most of the evidence analyzed in this report was collected through the medium of the Operative Bakers' Union. Inquiries addressed to the associations connected with the master bakers drew forth a general statement that bakers' dermatitis was uncommon among the members of these associations. In the survey of 658 bakehouses in Liverpool in which forty-eight cases of supposed bakers' itch were discovered there were seven instances of master bakers' being affected. Apart from the position of independence, however, there is not always any social superiority in the case of master bakers, who are often themselves struggling op-

eratives working, not infrequently, under conditions less favorable than those under which certain journeymen bakers work.

Methods of Manufacture in Bakehouses.—All bakehouses are divided by the trade into "machine" and "hand shops" and this distinction also determines whether a baking establishment should be considered as a "factory" which is — or was — chiefly under the supervision of the Home Office or as a "workshop" where the Health Authorities only are concerned.

There are 40,000 bakeries in England and Wales, and, according to the General Secretary of the Operative Bakers' Union, machinery is used in about 25 per cent. of this total number. This percentage is increased to 50 per cent. in town bakeries and probably is becoming higher each year. The amount and importance of machinery in a machine shop evidently varies very much; in a great number the machinery is limited to a revolving drum in which the various necessary ingredients are churned into dough by an electrically driven motor. In such cases the dough-mixer attendant is brought into immediate contact with the dough when he removes it from the drum and fashions it into suitable sizes for loaf-making. In larger establishments the mechanical processes are much more elaborate; in one factory inspected, the only work left for human hands to accomplish is to pass on the final lump of dough to the oven tray.

The opinion generally expressed in places where dermatitis has been observed is that most of the patients had, prior to their attacks, been working in hand shops where the mixing of dough ingredients is a manual operation. In South Wales the relationship between bakers' itch and "hand-made shops" is so universally credited that the district secretary of the Operative Bakers' Union has great difficulty in finding work for unemployed bakers, who are not inclined to accept employment in any but "machine bakeries."

Of 92 patients who were specially reported as suffering from bakers' dermatitis, 60 had been employed in hand shops, 26 in machine shops, and 6 in establishments where both processes were in vogue. In 20 of the 26 cases reported from machine shops the patients had been employed either in attending to the dough mixing machine and the molding of bread, or in the manufacture of confectionery. Contact with dough or a close connection with the processes of its making, therefore, seems to be of prime importance in the causation of bakers' itch.

Sex.—With few exceptions the cases of bakers' itch which have been reported occurred in men. This is not surprising because the Amalgamated Union of Operative Bakers, which has proved the chief source of information, contains only male members. Moreover, the comparatively few women who conduct business as bakers apparently do not undertake the actual mixing and baking of dough. Women, and young women especially, however, are extensively employed in the making of confectionery and nearly all cases of dermatitis among women which came under notice were undoubtedly due to the handling of sugar. In two cases of women bakers seen at Liverpool the dermatitis had probably nothing to do with the act of baking, and in one of these two instances the skin affection had a strange and recurring coincidence with the pregnant state.

Age.—The average age at which the condition first appeared in the case of 100 bakers concerning whom histories have been supplied was just over 4

the eldest patient was 64 and the youngest 19.[2] The condition proved most intractable in elderly men and in their case also the pruritus and subsequent lesions were not confined to the arms and hands, but involved the whole body, more or less. No less interesting, also, is the fact that in a large number of instances the primary attack of dermatitis occurred after many years of immunity from dermatitis and toward the close of the patient's baking career. The average length of service before attack works out at twenty-six years.

Alleged Causes of Bakers' Itch.—The questionnaire sent to individual bakers included a request that each recipient should mention what, in his opinion, was the immediate cause of his dermatitis. More than half of the patients either left the question unanswered or stated that they were not aware of any cause. The remaining 41 suggested the following reasons for their illnesses: flour (20 patients); Chinese flour (3); war flour (2); imported flour (2); brown flour (1); yeast (3); sugar (3); acid phosphate of lime (2); making dough (2); cream powder (1); salt (1); exposure to heat (1). One patient stated, "I suspect the trade generally."

The opinions of the district secretaries are expressed below:

District	*Alleged Causes*
Rochdale	"Sugar and fats being beaten up by hand; the gritty sugar causing scratches."
Birkenhead	"Working in the heat; pores of skin becoming choked with flour dust."
Northumberland	"Dough making; hands continually wet."
Warrington	"Dough making by hand."
Staffordshire	"Handling of flour and sugar."
Bristol	"Some chemicals in flour and sugar."
Northern District	"Sugar."
Liverpool	"Bleaching flour with acids."

The more important of the various causes put forward by the members of the Operative Bakers' Union may be examined in greater detail.

Flour.—It is not unnatural perhaps that the main ingredient of bread should be the chief object of suspicion, but there is much diversity of opinion concerning the way in which the flour is supposed to be harmful.

A "show case" seen at Cardiff illustrates one method by which flour, acting merely as a mechanical powder, may contribute to the formation of a dermatitis. The patient in this instance was a young baker who naturally perspired freely, especially about the head; as a consequence he had much difficulty in preventing the flour from settling on his face and becoming encrusted there. When seen he was suffering from an impetiginous condition of the eyebrows due to secondary infection set up by scratching. Though presented as a case of bakers' itch, the condition in this individual baker might have been produced by any other dusty material. Using this example as a criterion it becomes necessary to question the diagnosis of bakers' itch in cases where not the hands, but only the face of a baker is the site of dermatitis.

Dry flour as mere dusty material, however, cannot often be the cause of dermatitis, for the evidence of millers is overwhelmingly against such a hypothesis. In the replies from eighty-four milling firms in England and Wales, there were only two instances in which

[2] Dr. Oscar de Jong, in a personal letter dated Nov. 28, 1923, relates the case of a girl aged 15 who began mixing dough in December, 1922. In June, 1923, she had an outbreak of dermatitis on both forearms. She stopped work and returned cured in six weeks. In October, 1923, she had another attack, which ended in two weeks as a result of local treatment and ceasing work.

any cases of dermatitis were quoted. In one of these the three affected men had less to do with handling flour than any of their workmates, and the condition of their hands (the arms were free) was due to their occupation of tying up the bags with jute; in the other instance the girl who suffered from eczema had been similarly affected before joining the staff and when engaged in a different occupation.

In Liverpool, and to a less extent in South Wales, suspicion among the patients fastens on the fact that during the war, when some of the usual granaries of the world (Russia, Roumania, etc.) were closed, inferior grades of flour and foreign substances were used. Chinese flour in particular was considered to have an evil influence. I could not discover in what way this deterioration in the quality of flour—which certainly did exist during the war—was supposed to affect the bakers, but in Liverpool it was a fixed idea with many that Chinese flour was the cause of their trouble "and the Government ought to do something about it." It would not be easy, however, to associate any particular case of dermatitis with flour from China or anywhere else, for the reason that the master baker does not deal exclusively with one miller but mixes various grades of flour derived from three or four firms, while the millers in their turn make a blend of flours they receive from different parts of the world before retailing their products to the baking trade. A single loaf, therefore, may be of a very heterogeneous composition. The district secretaries who expressed their views on the causation of bakers' dermatitis did not mention the question of war flour and, moreover, a large proportion of the Chinese flour "school" were attacked some time after the return of normal conditions in the milling trade.

But while the clamor of some has been directed toward the unnaturally dark appearance and doubtful origin of war flour, the suspicion of others has been aroused by the pure whiteness of the post-war flour, and among these latter are some of the union officials. The methods of bleaching flour are not obtrusively in evidence at a flour mill, but from what I have been able to learn of the matter there seems to be nothing in the process as commonly adopted at most mills which would give rise to dermatitis in a baker at some subsequent period; also, the absence of dermatitis among millers may be quoted once more. The nitrogen-peroxide method is generally used in the bleaching of flour but since this gas is now produced by electrical means (which, according to Dr. Hamill (6), are rapidly superseding chemical processes) there is little chance of any acid condensation. The district secretary for the South Wales District (O. B. U.) asserts that he knows of one milling firm where bleaching is carried out by means of chloride of lime.

The presence in flour of *insect pests* was not suggested by any of the patients or by any trade union officials. Because of the fact, however, that various insects found among figs (carpoglyphus sp.) and in grain and sacks (pediculoides ventricosus; tyroglyphus sp.) are capable of producing irritating skin lesions, the possible existence of such pests was kept in mind. While several acarids and other insects are found in grain, the only acarid which was found by the Committee on Grain Pests to thrive in flour was *aleurobius farinae*. This mite is one of the non-parasitic or forage acari of the family tyroglyphidae and is in reality an accidental immigrant though it has been responsible for much damage to flour in Liverpool. It closely resembles the sarcoptids that cause acariasis in

horses, and it is capable of giving rise to considerable irritation of the human skin.

The only positive allusion to the possible part played by an acarid insect in the causation of bakers' dermatitis was made by Dr. H. McCormick Mitchell of the Liverpool Skin and Cancer Hospital who considered that between 55 and 65 per cent. of the 180 cases of bakers' dermatitis seen by him during the years 1914 to 1921 were due to an acarid. Unfortunately, Dr. Mitchell did not keep any of the microscopic preparations which had satisfied him that acari were present nor was it apparently possible for me to see any of the patients. Dr. Mussen, the Assistant Medical Officer of Health for Liverpool, on my informing him of Dr. Mitchell's cases, had fifty-nine different samples of flour examined at the City Laboratories but none was found to be infected. I had an interview with the City Analyst who has been engaged for some time in testing grains and meals, and he informed me that he had not, during recent years, found any samples of bakers' flour infested with mites. Similar investigations on a smaller scale conducted in other districts have failed also to incriminate these insects as a cause of dermatitis among bakers.

Sugar.—It has long been known that those who handle sugar are very prone to suffer from dermatitis. In days gone by, the laborers engaged at the Liverpool Docks in unloading stocks of sugar, from the West Indies, were accustomed to carry out their work clad in nothing but a loin cloth, and they did not reclothe themselves until they had bathed their bodies and removed the irritating particles of sugar. At the present day sugar dermatitis is common among persons working at trades which involve the use of sugar, such as the confectionery business. Thus Dr. Sequeira was "asked in 1919 to investigate cases of dermatitis occurring at a wholesale confectioner's. This trouble was attributable to sugar and was the result of a special process which has since been modified." Dr. Hamill also quotes the experience of a firm of biscuit manufacturers whose employees suffer from dermatitis to such an extent that a resident medical officer is necessary to deal with such cases.

In the present instance, also, there is no doubt that sugar has been an important factor in the causation of many cases of dermatitis. As mentioned previously, the number of personal papers which have been received from individual bakers suffering from dermatitis falls far short of the number of cases which are said by the district secretaries to have occurred even within the last two or three years. If these personal papers, numbering nearly 100, may be regarded as fairly representative, however, it is very significant to find that no less than 46 per cent. of the patients had been handling sugar during the course of their duties. Further, four out of the eight district secretaries who sent in an expression of their views mentioned sugar as a cause of bakers' dermatitis occurring in their districts.

In this connection there is the interesting statement of a leading baker in London to the effect that his foreman, when engaged in making "small goods and cakes," suffers from dermatitis which disappears when he resumes his duties in connection with bread-making.

Cream Powders.—In March, 1922, Dr. J. Howard Jones, Medical Officer of Health for Newport, wrote to Dr. MacFadden as follows:

Dear Sir,

Cases of chronic eczematous rashes on the hand and arm of bakers have been reported

to me. One of the bakers has attributed the rash to the use of Cream Powder ("A" Brand) in making cakes, etc. A sample of the latter has been analyzed with results as follows:

Acid sodium phosphate	70.70%
Rice starch	25.30%
Moisture	4.00%
Lead	6 parts per million
Arsenic	5 parts per million

I should be interested to know whether any cases of a similar nature have been reported to you.

(It may be mentioned that Dr. MacFadden has not since learned of any cases similar to those described by Dr. Howard Jones.)

Acid phosphate of lime was suggested as a cause by two patients in Liverpool but without much foundation; and in the case of one of the patients I was not satisfied that the papular rash could not be explained by another cause quite unconnected with acid phosphate or baking.

With regard to the Newport cases, sixteen samples of various cream powders were analyzed; eight samples showed acid sodium phosphate 70 per cent., and starch 30 per cent. Three samples contained a large amount of plaster of Paris; two others were composed chiefly of cream of tartar; while another one consisted almost entirely of pure acid sodium phosphate. At the same time the sixteen bakeries from which the samples were procured were visited, and these inspections resulted in the discovery of three cases of dermatitis. There was little in the way of clinical evidence to prove that the dermatitis in any of these instances was caused by a cream powder, but one patient gave a very plausible history. He stated that in November, 1921, the brand of cream powder known as "A" Brand was substituted for cream of tartar in the confectionery business at which he worked, and almost immediately after weighing and mixing this powder he felt tingling and smarting in his hands; this was followed by inflammation and a papular rash which had prevented him from working for nine weeks. No similar case has since been reported from Newport or elsewhere.

Yeast.—In three instances an attack of dermatitis was attributed to yeast but no reasons for this supposition were given. Dr. S. E. Dore cites the case of a baker who was employed at the Marylebone Infirmary and who attributed his attack of dermatitis to yeast. In the City of London Union Infirmary, also, the two resident bakers, while never themselves subject to dermatitis, stated that they had seen many cases in other bakeries. They considered that the condition was caused by want of cleanliness and by rubbing the arms on rough aprons, thus cracking the skin, which allows the dough to enter the small crevices; the fermentation of yeast then produces crops of small blisters. On the whole, however, the inquiries did not show that yeast was at all generally suspected as a cause of dermatitis.

Salt.—Salt as a contributory cause is mentioned once, by a patient at Sheffield. Full notes have been supplied also by Dr. J. F. Arlidge concerning two bakers at Fenton, near Stoke-on-Trent, who suffered from dermatitis which was possibly the result of handling salt. Two bakeries were involved and in both the bar salt used in the making of bread was dissolved by hot water in a galvanized iron bucket (4 pounds to the bucketful); this mixing was done by hand, as was also the subsequent mixing of the dough and brine. In one of the establishments where scones were made, a cream powder was in use for the purpose; in both instances, however, it was the operation of dissolving the salt which was supposed to have caused the dermatitis, and one of the patients had been previous[illegible]

attacked in the same way.

Dr. J. A. Barnes, a certifying surgeon in Lower Tottenham, reported to the Home Office a case of dermatitis caused by salt in December, 1921. In this instance the dermatitis was undoubtedly due to the increased strength of the brine solution used. The man in question had worked for some years with a solution of 1 pound of salt to 16 quarts of water without any ill effect, but when the strength was increased to 1 pound to 12 quarts, he began at once to suffer from a severe dermatitis of both hands and forearms which proved very intractable so long as he continued working; eventually the man gave up the business of baking.

Dough-Making.—Here and there it is suggested in the personal papers that dough-making was the cause of dermatitis; it is highly probable that to this particular process in the manufacture of bread can be ascribed a great majority of the cases of dermatitis among those employed only in bread-making as apart from confectionery. A very large proportion of those cases in which the dermatitis displayed a typical localization and in other ways was characteristic of bakers' itch relate to bakers who were intimately concerned with the preparation of dough. It has been pointed out elsewhere what a large percentage of the patients were accustomed to work in hand shops; in all such cases the affected men were daily engaged in mixing, kneading, or molding the dough. Moreover, in those bakeries which boasted machinery, it was nearly always found that when they provided cases of bakers' dermatitis, the men had been in charge of the dough machine or had handled the dough at some other stage in its manufacture.

The distribution of the skin lesions in genuine cases of bakers' itch finds a ready explanation when the technical details of the process of bread-making are observed. With shirt sleeves rolled up to just over the elbows, the dough-maker, working in a hot, and often poorly ventilated dark room, is kept busily and constantly engaged at his shift. During this time both hands and both arms are employed in the mixing, kneading, removal from the trough and loaf-shaping (molding) of the dough. At the kneading trough the naked hands and arms (hairy and perspiring, perhaps) of the baker are most intimately and most consistently in contact with dough; and this exposure to such a foreign element under the physical conditions of the baking room and the exigencies of the trade would seem quite sufficient in many cases—given certain personal factors—to cause dermatitis.

The Personal Factor.—There is seldom any reference to this aspect of the question in the reports and statements from members of the Bakers' Trade Union. Mr. Hiles, the District Secretary for South Wales, did, indeed, say in an interview that, whereas formerly the occurrence of isolated cases of bakers' itch betokened a lack of cleanliness on the part of individual bakers, now the condition is thought to be discreditable to the trade as a whole. Among the answers received from the London caterers and bakers, however, there are constant references to the individual responsibility of the patient himself; there is also in these references a striking unanimity of opinion as to the kind of negligence that disposes to dermatitis. The statement that "this affection of the skin only occurs when doughs are made by hand, due to the bakers allowing the dough to dry hard on the arms," which was forwarded by one manager, sums up the opinion of many others. Nor is this view of the matter entirely

confined to managers of high-class establishments, for it was frequently taken by master bakers in small businesses and not uncommonly by operative bakers themselves.

My own impression, also, as a result of visits to bakehouses and homes, coincided in many instances—though by no means in the majority of cases—with the views entertained by others as to personal responsibility. Many of the patients listed on a secretary's roll of cases had left the particular bakery at which they were first attacked—in large towns there seems to be a class of "jobbing" bakers who go from bakery to bakery finding temporary employment only. In such a class, personal neglect and careless habits, if not habitual to the man, would be engendered by the straitened circumstances of his home and the haunting uncertainty regarding his employment.

It might be answered that in such cases the man had been a product of his environment, and certainly many bakehouses which were visited did not conduce to habits of personal cleanliness and care. A sense of loyalty (or of expediency) on the part of operatives prevented any expressions of discontent with the manager's arrangements (or inadequate arrangements) in the bakery; but, in many of the smaller concerns, I saw no facilities for, and no inducements to, personal cleanliness.

Chief among such facilities may be mentioned the provision of washing basins, hot water, good soap, and suitable linen for drying the hands. As a general rule, these amenities were altogether lacking, and it is not difficult to understand the origin of dermatitis in the case of some of those who must perforce dry their hands and arms on their body clothes or on old sacking. One baking manager says, "In any case this complaint is very unlikely to occur in a sanitary bakehouse where proper washing facilities and clean towels are provided for the staff." Another writes, "In our French and Vienna bakeries, where all doughs are hand made, we have not got a single complaint, but we supply our men with plenty of hot water and pure soap (free from soda) and with clean linen cloth (not yeast bags as some of them use); *cleanliness is the most important factor.*"

Personal Predisposition.—Dr. W. Griffith, Physician to the Skin Hospital, Leicester Square, writes, "Usually the subjects are predisposed (ichthyosis or sweating hands)." In a case kindly shown to me at the London Hospital by Dr. O'Donovan the hands were not only sweating but were also very tremulous, and these two conditions are considered by Dr. O'Donovan to be present in many cases of occupational dermatitis, including bakers' itch. Dr. Kenneth Wills of Bristol has observed a coincident dandruff in the cases coming under his care.

Possibly there may be other diathetic factors at work in some instances, and the case of the woman baker whose dermatitis appeared only during the pregnant state may be recalled.

Among the cases of bakers' itch investigated during the inquiry, and concerning the diagnosis of which there seemed to be no doubt, were two or three of a severe and acutely relapsing nature. The patients were elderly men who had remained free from all skin affections during a long period of bakership and whose resistance it would seem had suddenly broken down toward the end of their careers. Such a case is that of a strong and otherwise healthy Manxman of 60 who began working at his trade when 14 years old and for nearly fifty years had remained free from any skin affection or other illness. He is the

father of ten children and for the last twenty-one years has worked consistently for the same firm of bakers; the conditions of his home life also pointed to the fact that he was a careful, experienced, and well-behaved workman. In March, 1921, this man noticed for the first time a rash on the wrists which spread upwards "as far as the dough went." In the course of a week, the nape of the neck was attacked, and then successively the mastoid regions, front of the neck, chest, back, legs and feet; the scalp was not affected, and the inguinogenital regions also were free from eruption. There was intolerable itching with bad insomnia, and the wretched man was at first inclined to attribute his condition to insect pests. This was found not to be the case, and his thoughts then turned toward his trade. He took a holiday in the Isle of Man, and the whole condition cleared up. On returning to work, however, he relapsed almost at once and within a fortnight his condition was as bad as ever. This experience was repeated on two subsequent occasions, and the man has had to give up his trade altogether, since it has become clear that he now reacts at once to some irritating influence at the bakery. This is one of the very few cases which was known to the Certifying Factory Surgeon. I was able to bring this patient under the professional care of Dr. Barendt at St. George's Hospital for Skin Diseases, Liverpool, who has kindly supplemented my own notes on the case. In this connection Dr. Harold W. Barber of Guy's Hospital (7) refers to individuals who "have an inborn intolerance of certain substances applied externally. . . . These irritants may be either protein or non-protein substances." As an example of the former, Dr. Barber quotes a case of bakers' eczema:

This eruption, when present, is confined to the hands and forearms, the part with which the flour comes into direct contact. The cutaneous reactions are strongly positive to wheat leucosin and globulin, but negative to gliadin and glutenin. He exhibits the phenomenon of local sensitiveness of his skin, since flour bandaged on his forearm, when he is free from eruption, causes itching, and later an eczematous dermatitis, whereas when applied to his leg it is without effect.

Dr. Boobbyer, who closely examined the circumstances of two cases of bakers' dermatitis at Nottingham, came to the conclusion that anaphylaxis was the determining factor in both instances. In one of these patients, a man of 60, the disease proved very intractable and the condition became exacerbated whenever work was resumed.

Protein sensitization, therefore, would seem to account for some of those cases in which, after long years of freedom, an elderly man suddenly becomes intolerant of contact with flour or dough. The reason why a baker's resistance should suddenly break down in this manner is not clear and it does not take us much further to note that certain elderly people in other walks of life suffer from an intolerable pruritus senilis.

Clinical Characteristics.—Like other occupational dermatoses, bakers' itch displays a localization that can be easily correlated with the particular processes of the trade in which the patient is normally occupied. The lesions in the first place are usually bilateral, affecting both upper limbs though not to the same extent. As a general rule, the hands and the exposed portions of the forearms are affected, and the eruption stops short at the rolled up edge of the shirt sleeve. The back of the hand and the extensor surface of the forearm seem to be chiefly involved, and in some cases the elbows bear irrefutable evidence of the manner in which the knead-

ing is performed. There is not the thickened, red and inflamed appearance of the skin at the base of the thumb which is so often seen in sugar workers. In a few cases there were patches of inflammation behind the ears probably due to auto-inoculation or, at least, auto-irritation. In severe cases, and possibly because of a general protein sensitization, covered portions of the skin become affected, and the whole body may be more or less involved.

FIG. 1.—Man aged 30; first attack. Eruption close-set, red, itching, and papular. Seen April 18, 1922. This case and also the cases shown in Figures 2 and 3 came under treatment at the London Hospital, and the reproductions are from photographs kindly supplied by Dr. W. J. O'Donovan.

FIG. 2.—Man aged 24; third attack. Hands and face affected; beard area and mastoid regions specially concerned. There was pruritus, folliculitis, and scaling. Lesions disappeared in one month under a course of malachite green. Seen September 20, 1922.

FIG. 3.—A very severe case in which an extensive folliculitis was followed by septic ulcers. Seen May 3, 1923.

Pruritus is apparently the first thing to be noticed by most patients though some have stated that their attention was first arrested by the appearance of a pimple; occasionally, but by no means always, itching is referred to the webs of the fingers, and the wrists are soon affected. The pruritus would seem to be associated with an erythema helped no doubt by rubbing and scratching on the part of the patient; there is no urticarial condition apparently at this or any stage but according to the histories given a vesicular rash often follows the preliminary symptoms.

So far, the baker has probably not felt it necessary to consult medical opinion; still less has it occurred to him to cease working. He continues to employ the usual methods of counter-irritation while carrying on with his work, and the result must often be that his crop of vesicles, now bruised and broken, become little portals for septic infection. A visit to the surgery then seems advisable and a diagnosis of "weeping eczema" arouses his interest; he is supplied with suitable medicaments and returns to the bakery where he may, or may not, keep the affected parts bandaged. As no improvement takes place he buys a box of ointment from the chemist, and since this proprietary unguent generally contains sulphur, the last state of the man is worse than the first. The proprietor of the bakehouse may now think it right to intervene, and the patient once more seeks medical advice and treatment; if

this contains instructions to leave off work, and they are carried out, the condition clears up in a comparatively short time. In other circumstances the patient continues at work, and though the suppurating lesions may have been checked a condition of chronic inflammation remains. There may be small discrete papular patches along the insides of the fingers, on the back of the hands, and about the wrists and forearms; or there may be larger areas of inflamed, indurated and furfuraceous skin resembling certain forms of lichen or, it may be, psoriasis. In some of the milder forms that were seen the condition resembled nothing so much as the "chaps" that appear on a schoolboy's hands in winter and was obviously due in these cases, also, to insufficient drying of the hands and arms. The dermal appearances, therefore, vary enormously according to the circumstances and personal factors in each case, and the course of the complaint is equally varied.

Where good treatment is adopted early relief is soon obtained, and many severe cases apparently clear up if the patient abstains from work while under treatment. But relapses are apparently frequent. Dr. Griffith of the Leicester Square Skin Hospital states that of the twenty to fifty patients seen on an average each year the great majority are "relapse cases with histories of previous attacks." Nearly 50 per cent. also of the patients who submitted personal papers gave a history of more than one attack; eleven patients reported three attacks, and two more mentioned four. When forwarding reports of two cases at Nottingham the district secretary added "Please note the new phase which has arisen. Insurance companies refuse to re-insure cases of Bakers' Dermatitis that have recovered on the grounds that the complaints will recur." This prognosis is certainly justified in those cases where a personal intolerance to the action of flour has developed, but it is difficult to estimate what percentage of the reported cases of bakers' itch come within this category. A certain number of cases which are looked upon as instances of relapse are, I feel sure, cases in which the patients have not been completely cured of their first attack, but have returned to work while still under treatment.

Some reporters have described themselves as "chronic cases" and some, through fear of losing their posts, do not obtrude their skin affection, avoid the doctor, and continue at work. Some of the patients whom I saw at Liverpool should not have been employed in the preparation of food, so morbid was the state of their hands and arms.

Treatment.—Only occasionally is there any reference to the treatment of cases, and such measures as are indicated testify by their variety to the different conditions exhibited by various patients. Dr. McCormick Mitchell advocates the use of mild astringents and antiseptic ointment; Dr. J. W. Flood, a Certifying Surgeon in Liverpool, finds that calamine lotion is the only useful remedy; in one case at the London Hospital malachite green was used successfully; the patients themselves are guided by the advice of the chemist or by the experience of neighbors in quite different circumstances.

Mild cases seem to respond fairly quickly to such therapeutic preparations as are easily suggested by the particular pathological conditions that may be presented by individual cases, provided that the affected parts are protected from further exposure and irritation. For intractable cases, however, nothing short of a change of occupation

appears to be of any service.

Prophylactic Measures.—These naturally will be suggested by a consideration of those factors which are thought to be responsible for cases of bakers' dermatitis. With regard to the question of flour, it is significant that, despite a widespread belief among bakers in the responsibility of this substance (by reason of its origin, adulteration, or bleaching), no definite preventive measures based on this assumption have been proposed by the union officials.

Some of the other factors to which attention is particularly drawn by the better class bakery establishments, by master bakers, and by independent operative bakers do suggest at once, however, certain measures which, if adopted, would undoubtedly diminish the incidence of this particular trade dermatosis. These measures may be divided into two classes — (1) those that concern the shop, and (2) those that concern the baker. Among the first class, the installation of dough-making machinery and the provision of proper toilet facilities are measures that are thought by many to be important. Granted such improvements, it would still be necessary for the baker, in many instances, to attend carefully to his bakehouse deportment and to avail himself of such toilet facilities as are provided.

Seventeen out of 100 patients who filled in questionnaire paper Q reported that other cases had occurred in their shops. No clear evidence of any case to case infection was discovered, but it is quite possible that a baker with an untreated or neglected suppurating condition of his hands and arms might infect others in the shop, either by direct contact or through the medium of towels, etc. The occurrence of multiple cases in one bakehouse is due, I suppose, to the congregation of susceptible individuals in a bakehouse where the working conditions are unsatisfactory rather than to any inherent infectiousness of the disease.

Summary of Conclusions

Bakers' Dermatitis and Dermatitis among Bakers.—It has been very difficult to estimate what proportion of the cases of dermatitis recently reported among bakers were in reality cases of bakers' dermatitis or bakers' itch. During the war and while demobilization was in progress, many of the patients said to be suffering from bakers' dermatitis were in fact suffering—like many other civilian ex-soldiers—from the more usual form of pruritus caused by the *Sarcoptes scabiei.*

There is plenty of medical evidence as to the increased prevalence of the ordinary itch during the period in which bakers' itch is alleged by the trade union to have become prevalent, but there is, with one or two exceptions, no corroboration from the medical side of the statement that bakers' itch has increased. The medical authority who alone reported a great increase of bakers' itch considered that 60 to 75 per cent. of his cases were caused by an acarid. A second dermatologist attached to another skin clinic in the same city definitely states, however, that in his experience there has been no increase in the number of genuine cases of bakers' itch; he had, however, large numbers of bakers suffering from scabies and other skin affections who attributed their ailment to their trade, for, as this authority states, "It is so natural, so human that we should refer our ills, our misfortunes and our diseases to the cause (animate or otherwise) that happens to be the most consoling to ourselves!"

One of the reported sufferers examined at Newport during the inquiry appeared to be recovering from an attack of scabies, and he volunteered the statement that it was the same complaint from which hundreds of his mates in the army had also suffered.

But, apart from scabies, other conditions have assuredly been included under the general designation "bakers' itch." Among the patients inspected were cases of impetigo, septic wounds, abrasions, erythema, etc., and it is justifiable to assume that all sorts of skin affections have been included under the term "bakers' itch" since the subject first attracted the attention of the Bakers' Union. It was in 1918, too, that the more general term "dermatitis" was introduced to cover the scheduled group of skin affections "produced by dust or liquids."

Bakers' Itch and Sugar.—If, from the total number of patients, all those who have handled sugar are excluded, the cases of true bakers' itch are still further reduced. It may be fairly argued, of course, that in certain bakeries the use of sugar is inevitable and that even if the sugar is the cause of the dermatitis it is still a case of bakers' itch. The irritating action of sugar, however, is well known, and sugar dermatitis is a common and well-defined complaint, affecting grocers, sweetmeat makers, certain biscuit makers, and others.

Alleged Increase in Prevalence.—The medical evidence is almost entirely opposed to the trade union contention that there has been any increased prevalence of bakers' itch, and most hospital authorities still consider this condition a comparatively rare form of occupational dermatosis.

The bakers themselves, on the other hand, are emphatic that there has been an abnormal prevalence of this complaint during and since the war. The truth would seem to be that within the last five to ten years there has been an unusual number of men who as bakers have complained of various forms of dermatitis, including a certain number of cases of bakers' itch. It is quite natural that the union officials who investigate the cases of men claiming sick pay from their union or compensation from their employers should consider as eligible for such consideration all bakers who have suffered from dermatitis during the course of their baking duties. No inquiry is made into the clinical circumstances and particular pathology of each case, and it is safe to assume, therefore, that many cases of dermatitis among union bakers should not be considered as cases of bakers' itch. The fact remains, however (although no figures have been given in support), that the Bakers' Union (O. B. U.) has been paying out, during the last five or six years, more money on account of skin diseases among their members than has previously been the case.

Alleged Continuation of Prevalence.—The increased prevalence of bakers' dermatitis is said by the Operative Bakers' Union to have started during the war and to have been maintained since this period up to the present time: "There are no signs of abatement," wrote the General Secretary on July 22, 1922. There is a great dearth of reliable records, however, and the concentration of attention on the condition since the present inquiry began has put out of focus the incidence of the disease during the last twelve months as compared with the incidence in previous periods.[3] The majority of cases

[3] The following are extracts from a letter of the General Secretary to the Bakers' Union, dated November 16, 1922.

"I am sorry to tell you that our Insurance Sec-

brought to our notice date back no further than 1920. Much of the criticism directed toward the elasticity of the term "bakers' itch" is applicable here also.

No particular *season* of the year can be associated with special prevalence of bakers' dermatitis.

Geographical Distribution. — Cases have been reported chiefly from the districts of Liverpool, South Wales, and Newcastle-on-Tyne; other places at which the condition has been observed are Manchester, West Riding of Yorkshire, Bristol, London, Nottingham, and Stoke-on-Trent. Bakers' itch, as far as its reported incidence is concerned, is certainly not general throughout the country, and the majority of all the cases are connected with the industrial districts near the seaport towns of Liverpool, Cardiff, and Newcastle-on-Tyne. There is, further, a distinct correlation between the local occurrence of cases and the centers of trade union activity. Liverpool, where a great majority of journeyman bakers are trade unionists, easily heads the list as far as numbers of cases are concerned; while from London, where the Operative Bakers' Union claims as members but a comparatively small number of bakers, only one case has been reported by the district secretary since the inquiry began.

Sex and Age.—With one or two exceptions, all the patients whose cases have been reported are men; very few women, however, are engaged as operative bakers. As a rule it would appear to be bakers approaching middle age who are attacked and in the more serious cases the patients are 60 years or over.

With regard to *environment, shop conditions and social status,* the following conclusions are drawn:

1. The greatest incidence of cases occurs in the more congested and unhealthy parts of a town.

2. Cases seldom arise in large, modern, well-equipped establishments; as a rule the bakeries at which the patients worked when first attacked are small, old-fashioned concerns lacking suitable toilet facilities, and often unsatisfactory in other ways.

3. The great majority of patients were employed in bakeries where the dough is, or was, made by hand.

4. Very few cases of dermatitis among master bakers have been reported; it is chiefly operative or journeyman bakers who appear as patients, and among these are some whose home conditions are unsatisfactory.

5. The question of personal cleanliness in the bakehouse is probably of much etiological importance.

Multiple cases in one establishment have been reported, but such events in this instance probably should not suggest that uncomplicated cases of bakers' itch are infectious.

Personal idiosyncrasy is probably displayed in two directions: (1) individuals liable to excessive sweating and possessing a nervous temperament are said on medical evidence to be susceptible; (2) in older men there is a very strong probability that *protein sensitization* is an important factor.

As to possible *exciting causes* of bakers' itch,

1. The suspicion in regard to the following seems to be unfounded: (*a*) Chinese and other unusual varieties of flour; (*b*) bleaching processes; (*c*) yeast.

2. The suggestion that an *acaris* may be responsible has not found any sup-

retary is unable to prepare for us a comparative table on the spread of dermatitis."

* * * * *

"Our District Secretaries' statements as to the number of cases compared with 1914 should be sufficient."

port as far as recent and demonstrable cases of bakers' itch are concerned. The fact that old stocks of flour in which the *aleurobius farinae* is chiefly found have long since been used up supports the conclusion that in recent cases of dermatitis, at any rate, a mite has played no part. If such an agency were at work one would also expect a much greater proportion of multiple cases than have in truth occurred.

3. *Sugar* is undoubtedly an important factor and has figured in the circumstances of a large proportion of reported cases.

4. *Salt, cream powders, and acid phosphate of lime* in certain isolated instances were responsible for causing a dermatitis among bakers.

5. The careless *handling of dough* without proper toilet precautions would seem sufficient in the case of a susceptible person to cause the condition known as bakers' itch.

Clinical features which have characterized undoubted cases of bakers' itch include:

1. A dermatosis localized as a rule to the hands and uncovered portions (ulnar side particularly) of the arms; the mastoid regions may not uncommonly be also affected, and in rarer instances the whole body.

2. There is nothing in the appearance of the rash particularly to distinguish it from various other trade dermatoses: itching is usually the first symptom and then vesicles or papules, but not wheals, appear; in long developed cases there may be patches of chronic inflammation suggesting psoriasis.

In some cases these are merely rimae suggesting the "chaps" of cold weather in persons who do not dry their hands efficiently.

3. The condition responds easily to treatment if the parts are protected from contact with dough.

4. Working with unprotected hands delays recovery or aggravates the condition; in severe cases there is a relapse after complete cure when the baker returns to his baking.

5. Except in these severe cases, where there is probably a protein reaction, constitutional symptoms are absent.

Bakers' Itch and the Bakers' Union (O. B. U.).—From the union's point of view the prevalence of bakers' itch is estimated in terms of money; that is to say, there has been, in certain districts, an unusual drain on the financial resources of the union due to sick pay distributed among bakers who have been under treatment for various forms of dermatitis. There is, moreover, as frankly stated by the Liverpool Secretary, a desire that more responsibility should be shared by the master in the matter of compensation.

Section 2 of the Statutory Order No. 287 of 1918 (Master and Servant) thwarts this desire and the Amalgamated Union of Operative Bakers would like to see it amended. This particular section states that "A person suffering from any of the diseases described in the Schedule as ulceration of the skin or any dermatitis produced by dust or liquids . . . shall not be entitled to compensation under the provisions of the said section on account of the said disease if he is disabled only for employment in the particular process in which the disease has been contracted."[4]

[4] As a result of the attention which the question of bakers' itch has recently received from the Home Office and the Ministry of Health it is proposed to amend paragraph 2 of the Secretary of States Order No. 287 of 1918 Master and Servant (Workmen's Compensation Act 1906. 6 Edw. 7, c. 58).

The sense of the paragraph in question is now materially qualified by the addition, after the ter-

Now, since bakers' itch is, after all, but a minor complaint unaccompanied, as a rule, by any constitutional symptoms and involving little disability except in the small proportion of severe cases, it follows that compensation can only be claimed hopefully in a small number of cases. A dough-machine attendant, for example, might be given other duties in the baker's shop which do not involve contact with dough or even flour, or he might be perfectly well able to follow some other occupation; in these circumstances no claim for compensation need be entertained by the employer.

It is also contended by some of the union officials that a baker's search for temporary employment in some other trade only adds to the existing general labor difficulties.

Bakers' Itch and the Public.—In his primary letter to the Ministry the General Secretary of the Operative Bakers' Union stated: "It is most unpleasant, in a Food Producing Trade, to find men suffering from dermatitis." From our inspection of bakeries we are able to state that there are grounds for this reflection and the nonchalance with which some bakers were plying their trade with arms extensively affected with a wet dermatitis was certainly disconcerting to say the least of it.

Suggestions for Prevention.—Believing, as I do, that the handling of dough is the chief factor in the primary causation and subsequent maintenance of bakers' itch, I offer the following suggestions:

1. A more general use of dough-making machines in bakeries.

2. The provision of proper washing facilities—hot water, suitable soap and a sufficiency of drying towels—in all bakeries where operative bakers are employed.

3. Greater attention on the part of the inspectors concerned to the hygienic condition of baking establishments and especially to ventilation. A special visit of inspection to bakeries from which a case of bakers' itch is reported seems advisable.

4. The prevention of bakers who are suffering from any form of active dermatitis of the hands or arms from continuing at the occupation of dough-making is desirable though sometimes difficult of attainment. The fear of a reduced income or even unemployment prevents a baker from going on the sick list and keeps him at work with a condition which needs a temporary abstention from his particular duties as well as medical treatment.

The use of rubber gauntlets, however, might shorten considerably the time which otherwise would be considered necessary to remain off duty while under treatment. Workmen do not take kindly to such preventives, but it might be brought home to them that the reputation of their bakery was at stake as well as the improvement of their own infirmity.

5. The comparatively rare cases where an intolerance to flour proteins, as proved by sensitization tests, has developed are outside the scope of any of the above measures for there is nothing left for such patients except to relinquish baking. This is an anxious prospect for an elderly man who knows no trade except baking, and such cases merit special consideration where compensation is in question.

Thanks are due to all who have kindly supplied the information upon which

minal word "contracted," of the following clause: "unless it is certified by the Certifying Surgeon, or on appeal by the Medical Referee, that the disease has been contracted through long continued exposure to dust or liquids in the industry in which engaged at the time of his disablement."

this report is based and among those who have given special help should be mentioned the following:

Dr. J. F. Arlidge, Certifying Factory Surgeon, Stoke-on-Trent.

Mr. W. Banfield, General Secretary, Amalgamated Union of Operative Bakers.

Dr. F. H. Barendt, Physician for Diseases of the Skin, Royal South Hospital, Liverpool.

Dr. J. A. Barnes, Certifying Factory Surgeon, Lower Tottenham.

Dr. Philip Boobbyer, Medical Officer of Health, Nottingham.

Mr. W. Edwards, District Secretary, Operative Bakers' Union, Liverpool.

Dr. W. Griffith, Physician, St. John's Hospital for Skin Diseases, London.

Mr. H. Hiles, District Secretary, Operative Bakers' Union, Cardiff.

Dr. Howard Jones, Medical Officer of Health, Newport, Monmouthshire.

Dr. H. McCormick Mitchell, Medical Officer, Skin and Cancer Hospital, Liverpool.

Dr. A. A. Mussen, Assistant Medical Officer of Health, City of Liverpool.

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Mr. Matt Pringle, District Secretary, Operative Bakers' Union, Newcastle-on-Tyne.

Dr. J. H. Sequeira, Physician, Skin Department, London Hospital.

Dr. T. W. Wade, Medical Officer, Welsh Board of Health.

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SICKNESS INSURANCE STATISTICS: AN ATTEMPTED SOLUTION*

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Introduction

FOLLOWING the introduction of compulsory sickness insurance in Germany in 1884 and in Austria in 1888, utilization of the statistical material on diseases and deaths collected by the insurance companies[1] was considered. At first all industrial workers and employees with limited incomes were obliged to join an insurance society; at the present time all workers and all low salaried employees are included under the terms of the law. The sickness insurance laws of both countries stipulated that the insurance companies should submit to the government authorities reports on membership, cases of sickness, and deaths, drawn up in accordance with a prescribed form.

In Germany the authorities were satisfied with the most important data, which gave an insight only into the general conditions in insurance companies, and this information has been sufficient up to the present time. The Austrian authorities, however, required that the insurance companies make detailed reports of two types: (1) reports giving the total membership, number of sick members and of deaths, number of cases of sickness and days of illness classified according to year of birth and sex; and (2) reports showing the cases of illness in each occupation arranged according to a special chart of 142 diseases. No list of occupations was supplied, however. The first type of report yielded little useful information, and statements of the second type were published only once because they were completely useless. And yet this unfortunate attempt to obtain useful statistics is extremely instructive; it shows us what happens when the compilation of statistics in a manner which requires an enormous expenditure of energy and money and, moreover, presupposes in the examining physician a skill in diagnosis which often is in contradiction with reality is made obligatory. I remember once seeing in a government publication tables painstakingly filled out in accordance with the prescribed illness chart. A few days later I looked at the medical record book from which the statistics were taken, and I found, to my astonishment, that it contained none of the scientific diagnoses included in the chart but gave only such descriptions as headaches, chest pains, stomach pains, etc. Up to 1904 the large Viennese insurance companies were the only ones that published detailed statistics compiled according to this plan (see Rosenfeld, S.: *Statistische Monatschrift*, 1905-1906).

In Germany a few insurance companies have attempted the compilation of sickness statistics. The Frankfurt sickness tables, based upon the data of the Frankfurt Local Sickness Insurance Company, were published in 1900. The exhaustive statistics of the Leipzig Local Sickness Insurance Company compiled by the Government Statistical Bureau are generally known.[2] They include all the cases of illness which occurred among members of the company from January 1, 1887, to the end of April, 1905. In the compilation of the statistics on illness by occupations, the classification of occupations used in governmental statistics was employed; and the disease chart used, based on the German list of causes of death, included 335 diseases grouped in five main divisions, one of which has ten subdivisions. Naturally such a division by diseases was possible in only a few of the very large occupational groups. The disadvantages of this disease chart (which is very similar to the International List of Diseases) will be discussed later. Since the report of the Leipzig Local Sickness Insurance Company was issued a number of companies have published their illness statistics annually on the basis of wholly different and often

*Translated by Carola Eliot, Harvard Medical School. Received for publication May 8, 1923.

[1] Throughout the article the German words *Krankenkassen* and *Mitglieder* have been translated as *insurance companies* and *policyholders*. These words may also be translated as *insurance societies* and *members*.

[2] Krankheits- und Sterblichkeitsverhältnisse in der Ortskrankenkasse für Leipzig und Umgegend. Berlin, Heymann's Verlag, 1910.

very curious disease charts, almost entirely without consideration of the ages of the members. The illness statistics of the General Local Sickness Insurance Company of the city of Berlin are very detailed, and take into consideration both sex and age. Its statistics for the years 1915 to 1918 have been worked up by the Government Health Board.

Up to the present time there have been only a few companies which have edited their material at all. Moreover, the published material is not comparable because every company uses a different disease chart, and because the payments of the companies and their other arrangements, as well as the economic status of the members, vary widely. These facts, however, are not evident from the statistics or the reports.

Last year the large unions into which the sickness insurance companies of the Rhine Province are combined, decided, at my suggestion and at the invitation of the government of Düsseldorf, to work out a plan for uniform sickness statistics for all the companies. A committee was appointed upon which a number of experienced insurance company managers, professional statisticians, and physicians served. Under my chairmanship, after thorough consideration of the problem, the committee drew up an outline of the fundamental principles of these statistics and at the same time proposed a method of working them up. It was clear to us all that our object could not be attained by theoretical explanations but that, on the contrary, the most minute details would have to be given as to how each company, large or small, should make up its statistics, and suitable charts and tabular forms would have to be worked out—in short, all the technical aid possible would have to be offered to the companies for the keeping of their statistics. All this was done by the committee. The insurance unions then recommended to their member companies that they compile their yearly illness statistics on this basis, and that they send one copy to the union and another to the medical inspector of factories (myself) for use in industrial hygiene. Numerous companies of the Rhine Province, the Westphalian companies, and a number of companies in other parts of Germany have agreed to draw up their statistics on this basis.

The following is a report on the principles of the proposed plan and on the observations, experiences, and facts upon which they are based.

Sickness Statistics

Age and Sex Classifications.—A division according to age and sex is fundamental in all sickness statistics. This fact is demonstrated by the following table from the statistics of the Leipzig Local Sickness Insurance Company.

Age	Cases of Illness[1]		Days of Illness	
	Men	Women	Men	Women
15-19	37.3	35.4	617.4	753.0
20-24	35.5	40.4	657.1	955.0
40-44	44.2	50.6	813.6	1,395.0
60-64	59.9	49.4	2,068.7	1,631.7

[1]Per 100 compulsory policyholders.

The ratio between the two sexes is not the same everywhere. In the Viennese Union of Sickness Insurance Companies the percentage of illness is consistently lower among the women than among the men, and also the number of days of illness is smaller among the women than among the men in most of the age groups. This depends largely upon the interaction of physiological and social circumstances. The marked differences between the various age groups, however, exist everywhere; variations occur only in that the higher percentage of illness in the youngest group stands out with varying degrees of clearness in different companies. That the general disease rate, as well as the rate of incidence of particular diseases, varies in the different age groups, needs only to be mentioned.

The distribution of ages differs in the various companies, and also in the different occupations within the same company. For instance, in the Sickness Insurance Company of the ribbon makers in Vienna—a trade that is dying out there—three-fourths of the members were over 30 years of age; while in the Sickness Insurance Company of the hairdressers, three-fourths of the members were under 30 years of age. It is obvious therefore that the general illness frequency in the ribbon makers' company should be much higher than in the hairdressers' company, and it is just as obvious that sexual diseases should be more numerous among the hairdressers than among the ribbon makers. In the Leipzig Local

Sickness Insurance Company 79 per cent. of the clerks, 65 per cent. of the carpenters, and 58 per cent. of the masons were under 35 years of age. It is apparent, therefore, that in order to be useful, all morbidity statistics should be arranged according to age and sex.

Limitations of Insurance Statistics.—For which diseases can we use the insurance company statistics? Obviously only for those concerning which reliable and accurate records have been gathered for other purposes, because no company will go to the heavy expense of collecting data on diseases for the sake of the statistics alone. Even if the managers of the company wished to do this, the execution would probably fail as a result of passive resistance and of misunderstandings between the company officials and the company physicians. We all know how unwillingly the majority of physicians undertake to keep records for statistical calculations. The management of the large Viennese Union of Sickness Insurance Companies, in which I worked for fifteen years, wished to have the physicians keep records, for purely statistical purposes, of the cases of illness under their care in which the patients continued at work. Many physicians kept no records of these cases; the majority kept them in an absolutely unreliable way; hardly one kept them accurately. On the other hand, the cases of sickness which entail absence from work are, through necessity, accurately recorded in every sickness insurance company, because for these cases daily sickness money is paid, and this payment itself obviously requires an accurate record. It is clear, therefore, that only the diseases causing suspension of work can be utilized for statistics. The consequences and difficulties arising from this limitation will be discussed later.

Next let us consider for what purpose and how such statistics are to be compiled. Since the insured are never identical with the general public but always represent only special groups of the earning population, we can never use insurance statistics to ascertain the health of the total population; we can use them only to draw comparisons between the groups of persons insured.

Occupational Classification.—The classification which has a particular interest for us is that according to professions or trades. Such a classification has not merely theoretical interest—statistical data dependent on the cooperation of many people can never be compiled for purely theoretical, scientific reasons—it has also a great practical significance. The investigation of the health conditions in occupations or trades shows us where practical and legal protection is needed. Sickness insurance statistics therefore can only serve the purpose of showing what influence various occupations and industries have upon the individual's state of health.

The ideal system of classification would be to ascertain the occupation of every insured person and to include all those belonging to the same occupation, or engaged in the same kind of work, either under a large trade group or under an individual trade. In most sickness insurance companies the statements of the occupation of each individual are so incomplete that nothing can be done with them. In the German general local sickness insurance companies, however, which include the most varied trades and factories of a locality, the factory or management to which every member and every sick person belongs is accurately reported. In the factory insurance companies which include only one trade, the membership in that trade is given; if the factory is rather a large one, however, data almost always exist to show in which division of the factory the individual works. Although it is almost always impossible to learn from statistical records the occupation of the individual, it is usually possible to ascertain the trade to which the individual belongs or, in the factory insurance companies, the subdivision of the trade. Lack of knowledge in regard to the individual occupation is not so serious as it at first appears. For example, when locksmiths, turners, and assistants are working in a machine factory they are all (the assistants as long as they work with the others) engaged in metal work. They are all exposed to exactly the same health hazards even though their individual occupations and their individual tasks may be different. Besides the metal workers, in a machine factory there are carpenters, painters and transportation workers but they constitute only 10 to 20 per cent. of the employees so that in the observation of the trade as a whole we receive only a slightly altered picture of the health condition for metal work. It is better, of course, if possible, to observe separately the

different occupational divisions in machine manufacturing. What applies to this industry is true also of most other industries.

The study of a particular trade, especially with reference to all other trades represented in the general local sickness insurance company, will give us valuable information concerning the special health hazards existing in that trade. In order to make such a study possible, it is necessary to group similar trades together, and to arrange all the trades in a special chart. It was therefore the first duty of our committee to draw up a special classification of industries so arranged that the industries in which the chief occupations and the health hazards are similar should be grouped together. The chart which we have adopted is very much like the official chart.

CHART OF INDUSTRIES AND OCCUPATIONS

Farming, gardening, animal raising, forestry, and fishing.
Mining, foundry work, salt work, peat cutting.
Stone and clay industries.
Metal working, manufacture of machines, instruments, and apparatus.
Chemical industries, industries dealing with the by-products of forestry, with substances used for illumination, with soaps, fats, oils, varnishes; and the utilization of animal wastes.
Textile industry.
Paper industry.
Leather industry.
Wood and shavings industry.
Industries concerned with food essentials and accessories.
Clothing and cleaning industries.
Building industries (excluding locksmiths and carpenters).
Printing and other reproducing processes; industrial art work.
Commerce.
Public service (government offices, churches, insurance companies, banks).
Transportation.
Hotel, restaurant, and bar.
Domestic service, excepting farm servants.
Musical, theatrical, moving picture, artistic, and painting professions, nursing and medical service, and the liberal professions.
Professions and trades which cannot be included in any of the foregoing groups, and the irregularly employed.

Further subdivision seemed unnecessary, since only comparatively few local sickness insurance companies have over 50,000 members, and too great a division of the material should be avoided. It was carefully emphasized that the large local sickness insurance companies might make a special subdivision for any occupation to which at least 2,000 members belonged. A local sickness insurance company to which a large number of breweries belong can thus lay particular emphasis on that group; a local sickness insurance company to which a large number of butchers, and another to which a great many tobacco workers belong can stress these occupations. The fact that the local sickness insurance companies, because of the number of trades represented, must divide their members (both well and ill) into twenty trade groups makes their statistics much more complicated than those of the factory sickness insurance companies. Small factory sickness insurance companies—and there are many such in Germany—need not and cannot make subdivisions, for when the absolute number of members is very small the resulting sickness reports are too greatly influenced by chance. The sickness insurance companies of large factories should and do make subdivisions. As examples the divisions of the chemical industry, of mining, and of foundry work are cited.

Chemical Industry:

Artisans exposed to chemicals (making repairs).
Artisans not exposed to chemicals (carriers, drivers).
Workers in factory for inorganic chemicals.
Workers in factory for organic chemicals.
Technical work.
Office work.

Mining:

According to the minerals extracted:
Workers above ground.
Workers under ground.
Allied industries (coke, tar, gas, and other products).

Foundry Work:

Smelting.
Pouring and refining.
Roller and hammer work.
Generating.
Thomas slag mills.
Sulphuric acid factories.
Mechanical trades.
Other trades.

The number of subdivisions in even the largest establishments is small in comparison with the number of groups in the general local sickness insurance companies. For the sake of uniformity, and in order to avoid subdivisions made from different points of view which would render comparisons impossible, all the industries should come to an agree-

ment about their plans for division with their unions or with the medical inspector of factories.

Before we turn to the classification of diseases it must be clearly understood that not only the sick members but all members of the sickness insurance companies must be catalogued according to the above-mentioned points of view: sex, age, industry, and subdivision of the industry. Only this arrangement will make it possible for us to compute averages; the general morbidity rate and the morbidity rate for a particular disease are determined by the number of cases among 100 members. It is unfortunate that in the local sickness insurance companies the classification of members according to industrial groups involves so much work that as a rule it can be made only once a year (on December 31). This means that an inaccuracy exists owing to the variations in the membership during the year; if this error were very great it would have to be compensated for by computing the membership on a second day and averaging the two figures. The average membership must be computed, and in the factory sickness insurance companies it is possible to do this. The more frequently the membership is computed, the more accurate the result. The simplest, and at the same time a very accurate, way would be to count the membership on the first of every month and on the last of December (in factories and also in subdivisions of factories with the help of the payroll it will not be at all difficult), add all the results, and divide by 13. The making of the age divisions is somewhat difficult and tedious. For this one might as well be satisfied to undertake the computation of the age groups on one day, for instance, on December 31, and to transfer the resulting figure to the average number of members computed according to the method outlined above.

Disease Classification.—For the statistical reporting of illness a disease chart is necessary. The various diseases must be classified in a few disease groups because no sickness insurance company could record 100 diagnoses side by side with any ease, and because too many disease groups would mean that even in large companies the number of cases occurring in each group would be small.

In drawing up a disease chart the list of diseases ordinarily used cannot be followed by insurance companies. This is based upon the International List of Causes of Death, which lays especial emphasis on the infectious diseases. Excepting grip, however, these diseases play a limited rôle among sickness insurance members because the most common among them—measles, scarlet fever, and diphtheria—attack children especially. With regard to the other diseases the authors of the international list adopted an arrangement from the purely topographic-anatomic point of view, rather than from the etiologic point of view because opinions with regard to etiology varied. What interests us for the sickness insurance statistics is the etiologic aspect. Which trades lead to diseases due to chilling? Which ones lead to diseases of the digestive organs? Which lead to early wearing out of the heart and arteries? If, according to the international list and those based upon it—for example, that of the German Government Health Board—pharyngitis and inflammations of the throat are classified with diseases of the digestive organs, the number of cases of diseases of the respiratory tract is decreased by one-fourth to one-third, and the number of cases of diseases of the digestive organs is correspondingly increased. If inflammation of the veins and inflammation of the lymphatic glands are included among diseases of the circulation—a classification which is, to be sure, anatomically correct—the picture is essentially altered through this grouping. Anyone who does not understand the principles of such a classification will be misled, especially since the frequency of a particular disease varies in different industries. The following table based on the statistics of the Leipzig Local Sickness Insurance Company is cited by way of example.

	Clerks[1]		Mason's Laborers[1]	
Disease	Cases of Illness	Days of Illness	Cases of Illness	Days of Illness
Diseases of the circulatory organs	12.20	369	15.00	481
Diseases of the veins	2.05	50	5.94	122
Inflammation of the glands	0.90	11	1.88	42
Diseases of the heart and arteries	9.25	308	7.18	317

[1]Ages 35-54.

Thus among the mason's laborers there are more cases of diseases of the circulatory organs than among the clerks, but fewer cases of diseases of the heart and arteries which we think of as belonging above all others to the diseases of the circulation.

There is another matter which requires consideration—namely, diagnosis. Many physicians avoid writing the word tuberculosis on the sickness money certificate which comes under the eye of the patient himself; instead they write down a symptom of the disease, such as hemoptysis, costal pleurisy, or a palliative, such as pulmonary catarrh or pulmonary disease. According to the usual chart these diagnoses are filed under diseases of the respiratory organs, and so it happens that in statistics of the Leipzig Local Sickness Insurance Company among 1,000 members there are 8.4 cases of tuberculosis of all kinds, but under "pulmonary disease" there are 12.65, under violent hemoptysis and hemoptysis 1.88, and under pleurisy 6.26. In reality, therefore, there were 29.19 cases of tuberculosis, but only 8.4 were reported as such. In the same way there were only 620.5 days of illness reported as due to tuberculosis, while actually there were 1,272.9. It is possible to work out the real figures for the tuberculosis cases in only a few trades, even in as large an institution as the Leipzig Local Sickness Insurance Company, since, in the majority of industries, only the classification according to disease groups appears in the published work, and the diseases which I have just mentioned (hemoptysis, costal pleurisy, etc.) disappear under the heading "diseases of the respiratory organs." The statistics of the Berlin General Local Sickness Insurance Company show 485 deaths under pulmonary tuberculosis, but 1,147 under "pulmonary disease" and 16 under laryngeal catarrh. It is the same with other diseases. The physician very rarely writes the word "abortus" on an illness certificate; instead he writes the palliative, "uterine hemorrhage." Uterine hemorrhages following miscarriages are so much more common than uterine hemorrhages due to other causes that for our statistics it is better to include all uterine hemorrhages in the same group rather than to report a limited number of miscarriages and let the majority of miscarriages disappear under "diseases of the genital organs."

By grouping together diseases which are etiologically homogeneous, and by taking into consideration the existing customs and errors in the establishment of diagnoses, we succeeded in drawing up a disease chart which differs essentially from the chart now in general use.

DISEASE CHART

1. General condition of weakness, anemia, chlorosis.
2. Tuberculosis and suspected tuberculosis.
3. Syphilis.
4. Gonorrhea.
5. Grip.
6. Other infectious diseases.
7. New growths (benignant and malignant tumors).
8. Diseases of the nervous system.
9. Diseases of the respiratory organs.
10. Diseases of the heart and arteries.
11. Diseases of the stomach, intestines, and liver.
12. Uterine hemorrhages and miscarriages.
13. Diseases of the urinary tract and of the genital organs (excepting 3, 4, and 12).
14. Skin diseases.
15. Muscular and joint rheumatism, and gout.
16. Other diseases of the organs of movement.
17. Diseases of the ears (except wounds).
18. Diseases of the eyes (except wounds).
19. Injuries and other results of external agents (except 20) and their consequences, including wound infection.
20. Industrial poisonings.
21. Other diseases and special diagnoses.

Group 1 of this chart is of importance for women members, among whom anemia and chlorosis largely occur. Under group 2, tuberculosis and suspected tuberculosis, belong the diseases which I have already mentioned. If bronchitis is recorded on an illness certificate, one should be careful to notice whether this member has been ill before with tuberculosis or with one of the diseases suggesting tuberculosis. If he has such a history, his illness must be looked on as tuberculosis, and must be classified as such. Similarly, a member under 50 years of age who has been ill repeatedly for a long time with bronchitis or chronic bronchitis must also be considered a tuberculous patient. Groups 2 to 7 and group 20 take precedence, and any illness resembling the disease of any one of these groups is always classified under it. For instance, tuberculosis of the brain is classified under tuberculosis, not under diseases of the brain; uterine cancer is classified under tumors, not under diseases of the sexual organs. Only one exception is made to this general rule; late syphilitic diseases of the nervous system, progressive paralysis and tabes, are

classified as nervous diseases, partly on the ground that, especially in their early stages, it is difficult to differentiate them from other nervous ills, but chiefly because classifying them under the sexual diseases would make it impossible to distinguish new cases of the latter.

The number of cases reported under groups 3 and 4 will always be small because in only a few cases do these diseases lead to suspension of work. The handling of groups 5, 6, 10, 11, and 12 is clear from what has been said above. All sorts of rheumatism are brought together in group 15; acute rheumatism of the joints is classified under it because from experience we know that the insurance company physicians do not differentiate these conditions clearly, and in many cases of recurring rheumatism the line between the acute and the chronic forms is difficult to draw. Wound infections are classified with wounds in group 19. It seems illogical to place them under an absolutely new heading as is done in the customary disease charts. A wound may heal cleanly or an infection may follow; but first it was a wound. All diseases not included in a special category are gathered together in group 21. There are many such diseases, but it is our experience that they constitute only 3 to 4 per cent. of the cases reported in the insurance companies. When there are two diagnoses given on the sickness certificate and one is the result of the other, the classification is made according to the basic disease; for instance, "tuberculosis, anemia" is classified under tuberculosis. When a chronic condition is followed by an acute disease which is not a more acute form of the first trouble, the classification is made according to the disease which led to the sickness report. For example, an illness of short duration reported as "tuberculosis, angina" is classified under angina (disease of the respiratory organs). When a policyholder is reported many times within a year for the same chronic disease—for example, for tuberculosis—it counts as only one case of illness.

Explanations such as those which I have mentioned here are added to the chart in order to show the correct method of classifying the diseases. Even the most detailed explanations, however, would not guarantee a uniform classification, especially as the classification is almost never done by the physician, but rather by the insurance company clerks. For this reason we have added an alphabetical index to the chart which gives all the scientific and popular names of diseases with the number of the group in which each is to be filed. If the classification is still doubtful, the chief physician of the insurance company or the government industrial physician is consulted.

It is, of course, of the greatest importance that the medical diagnoses should be as reliable as possible. Since the physician on making his first sickness report must write some diagnosis on the sickness certificate, even though a correct diagnosis is not yet possible, care must be taken that he gives the correct final diagnosis on the recovery report. We are trying to attain this end by having the question "Final Diagnosis?" printed on the sickness certificates.

It should be emphasized carefully that this disease chart cannot satisfy all the demands which special situations may give rise to. In a region where cases of typhoid fever are frequent it would be well to add a special heading for it; in industries in which skin diseases such as eczemas are caused by the working process, a special heading should be added for them. The physicians and the managers of the sickness insurance companies together must decide from time to time when to add such supplementary headings. The possibility of comparison with the statistics of the other insurance companies will not be impaired because these new headings can always be calculated with the main headings.

In the smaller companies the technical working up of data can be simpler than in the larger companies.

On every report of recovery the disease can be marked with a stroke against the appropriate heading on the tabular form and the strokes can be added at the end of the year. In the larger companies the statistics will have to be worked up with counting cards; under certain circumstances the sickness certificates themselves can be used, but in other cases special counting cards for each illness must be prepared. It is very practical to arrange the sickness certificates so that they may serve as counting cards. The technic for the work is carefully explained in the out-

FIGURE 1
SECTION OF TABULAR FORM FOR TRADE SICKNESS INSURANCE COMPANIES[1]

Betriebs-abteilung	Alters-gruppe (1.—6.)	Durchschnittl. Zahl der Kassen-mitglieder im Jahre ..... m.	w.	I Allgemeine Erschöpfungs-zustände, Blutarmut, Chlorose m.	w.	II Tuberkulose und Tuberkuloseverdacht m.	w.	III Syphilis m.	w.	IV Tripper, weicher Schanker, Bubo m.	w.
1	2	3		4		5		6		7	
	1. bis 20 Jahre			x / xx							
	2. 21—30 Jahre										
	3. 31—40 Jahre										
	4. 41—50 Jahre										
	5. 51—60 Jahre										
	6. über 60 Jahre										
	Zusammen										

[1]The complete form contains a separate column for each of the twenty-one disease groups included in the chart, three additional columns for special classifications, and a column for the total number of cases of illness in each age group.

x This space is for recording individual cases of illness.

xx This space is for the total.

lines and directions which the unions hold at the disposal of their member companies; the proper forms may also be secured from the unions.[3]

As has already been said, the statistics and the tables of the general local sickness companies are more complicated owing to the number of industries represented. Since the factory sickness insurance company is of most interest to Americans, a section of the tabular form for factory sickness insurance companies is given by way of illustration (Fig. 1). If a factory sickness insurance company is able to work out the statistics for its various subdivisions, a special sheet will be needed for each subdivision.

It has been contended by many that the number of days of illness gives a better idea of the health conditions than the number of cases of illness. It is true that the number of days of illness is of especial interest from the standpoint of the insurance finances, and that it is contrary to medical opinion to regard pharyngeal catarrh or stomach catarrh as one case, in the same way that we do meningitis, tuberculosis, or cirrhosis of the liver. According to the statistics of the Leipzig Local Sickness Insurance Company, the duration of illness from particular diseases is as follows:

	Duration in Days
Inflammation of the throat	10
Inflammation of cell tissue, muscular rheumatism, stomach catarrh	15-18
Bronchitis, neuralgia, soft chancer	21-25
Inflammation of the veins, pleurisy, inflammation of the brain	about 28
Epilepsy, endocarditis, neurasthenia, typhus	30-34
Tuberculosis	80
Tabes dorsalis	86

One might say here that the number of days of illness per member would give us a somewhat better idea of the actual prevailing health conditions than the sickness frequency, or the number of cases of sickness per 100 members. On the other hand, these figures—for example, the list of diseases which take twenty-eight days, and of those which take thirty to thirty-four days—show that the number of days of illness is by no means an index of the significance of the illness, that diseases of totally different significance may require the same number of days. The advantage which the number of days of illness may have over the number of cases of illness disappears wholly, moreover, when the question is not one of total illness figures, but one of considering diseases divided into groups according to a special chart like that outlined above (p. 439). The mere heading of each group shows us the inner significance of the diseases belonging to it; in order to reveal the importance of a disease, therefore, we need not compare its duration with that of diseases in other groups. When we know that a person's illness is due to tuberculosis, arteriosclerosis, tumor, or industrial poisoning, this fact means much more to us than the number of days occupied by his illness. In our sickness statistics, therefore, the number of cases of illness in the special groups will have a greater significance than the number of days of illness. In this connection two other things should be taken into consideration. First, the calculation of the number of days of illness requires extra work which only a few insurance companies will undertake. For the purpose of counting the cases of illness, counting sheets or sickness certificates can be used. These sheets or certificates can be counted very quickly and the number of cases of illness obtained. In order to ascertain the total days of illness the number of days on the record cards of every group must first be added. Secondly, it should be observed that the number of days of illness is much more influenced by outside conditions than is the number of cases of illness. This will be discussed later.

We are therefore forced to the conclusion that when a properly arranged sickness chart is used, the number of cases recorded under each group is of greater importance than the number of days of illness—that is, the disease frequency is of greater significance than the number of days of illness. If an insurance company can offer us both, this is, of course, to our advantage.

Factors Affecting Reporting of Illness.—What information do the figures which we receive from the insurance companies give us? They tell us how many illnesses with suspension of work there have been. Whether

[3] Vereinigung rheinischer Krankenkassen. Düsseldorf, Elisabethskasse 10; Verband rheinisch-westphälischer Krankenkassen. Essen, Ottilienskasse 5.

an illness leads to suspension of work does not depend upon medical opinion alone, except in the case of diseases accompanied by violent symptoms; even if this were the case, the advice of different physicians would not be the same. There are also various other factors concerned, particularly economic factors. For example, if a physician has an attack of grip during a bad grip epidemic, just when he has a great deal to do, he will continue at work in spite of fever, partly from a sense of duty and partly for economic reasons. Yet he has perhaps gone to bed with a less severe illness at a time when he was less busy. The workman does the same; the economic loss which he would suffer if he reported his illness (the difference between his wages and the sickness insurance money) and the fear of dismissal in case of illness influence enormously the number of reports of illness with suspension of work. The mason's laborer, for instance, will go to work, even with the severest kind of illness, four or five weeks before the close of the building season, because he knows that a sickness report means the loss of his job and the possibility that he will not find another quickly; while in the last days of the season or after the close of the season and after dismissal (when the obligation of the insurance company extends as far as this, as is the case in Germany), he will try to use even the most insignificant symptoms of illness for the sake of the sickness report because he now has nothing to lose and a sickness report means an income. All insurance men know that every regress in economic conditions, every increase in unemployment, every strike, every shut down, leads to an increase in the number of sickness reports.

Next to these general economic conditions, the regulations of the insurance companies themselves are of greatest importance. The influence of the amount of sickness money in comparison with wages is obvious from what has already been said. If full wages are paid during illness, a large number of cases always results. This is what happened among the gas workers of Berlin. In 1920, in spite of improved working conditions, there were 74.7 cases of illness per 100 workers, while in 1913 there were only 45.5. This is due to the fact that the municipal worker now receives full wages during illness. In addition to his wages he receives payments from the benefit fund of the labor union.

At the beginning of the war in Germany the rate of illness fell from 5.76 on July 1 to 2.57 on November 1, owing to the co-operation in war work which every one felt to be his duty, and also to the increasing difficulty in finding work. In the period 1914 to 1918 the death rate rose from 1.06 per cent. in 1914 to 2.17 per cent. in 1917, and 2.29 per cent. in 1918, as a result of the employment of the more delicate workers in factories and, more especially, the fearful deterioration of food conditions. The sickness rate, on the contrary, dropped considerably in 1915. This was due to the fact that, although wages and cost of living had increased, the amount of sickness money remained the same. It was not until 1917 (at the time of the doubled death rate) that the sickness rate again reached the height which it had attained in 1914.

The number of sickness reports depends, of course, not only upon the amount of cash benefit but also upon the other regulations of the insurance companies. Strict control of the sickness reports by confidential physicians and of the persons reported ill by inspectors will decrease the number of sickness reports; lack of control will increase the number. In order to be able to estimate the value of the published sickness report of an insurance company, therefore, we must be informed of the economic condition of the policyholders during the fiscal year; of the special events (strikes and shut downs); and of the insurance company's own regulations. A questionnaire was drawn up for the insurance companies which includes questions about all these conditions.

The influence of outside conditions which is seen in the number of sickness reports but not in the number of cases of actual sickness should lead us to be cautious in making comparisons within an insurance company. If, in a company in which different trades are represented, one particular trade is in a bad economic condition, that fact will be reflected in an increased number of sickness reports; if an industry in which the workers are insured in a sickness insurance company closes down one of its departments and dismisses its employees, many of them will report themselves ill. Even greater caution is nec-

essary in the comparison of two companies. It is usually unfair simply to add up the figures for the same trade in several insurance companies; before we do this, we must convince ourselves of the equality of economic and insurance conditions. As a matter of fact, the insurance statistics themselves often contain a notice that a high percentage of sickness reports is to be accounted for not by very poor health conditions but by outside influences. If we find a strikingly high sickness frequency in an insurance company, or in a particular trade, for all sorts of workers and all sorts of diseases, we shall be forced to the conclusion that it is not due to the unhealthful conditions of this trade, but that outside conditions are responsible for the number of sickness reports observed. A comparison of the number of sickness reports with the death rate will also give us valuable data. Thus we see in the Leipzig Local Sickness Insurance Company statistics that among the mason's laborers, who as seasonal workers are subject to a great deal of unemployment and change their jobs frequently, there is an extremely high sickness frequency and a low death rate in every disease group.

It should be noted that the number of days of illness is even more influenced by outside factors than is the number of cases of illness. This rises with the increase in the number of sickness reports brought about by economic conditions; and furthermore, the same conditions which lead to an increase in sickness reports also lead to the wish to remain ill as long as possible. Instances of increased number of sickness reports and increased duration of illness are more frequent among the so-called voluntary policyholders than among the compulsory policyholders. In the German and Austrian sickness insurance companies there are so-called voluntary policyholders in addition to those who must adhere to the rulings of the law as compulsory members. They are mostly former compulsory policyholders who, on the expiration of their insurance obligation, due to their leaving an occupation in which insurance is compulsory, have the right to remain insured. While the compulsory policyholders lose their wages when they are ill and receive instead sickness money which is much less than their wages, the voluntary members are either not earning, and therefore receive sickness money without loss of wages, or else they are compulsory policyholders in another insurance company because of a new job, and in case of illness receive sickness money from this source likewise—that is, double cash benefit (with a certain reduction). One should also remember that this voluntary membership consists of persons who are in poor physical condition. This leads to an abnormally high sickness frequency among the voluntary members. Among the members between the ages of 15 and 34 there are in the Leipzig statistics 36.6 cases of illness per 100 compulsory policyholders, and 81.1 per 100 voluntary policyholders; 689.0 days of illness among the former, and 2,475.2 among the latter. Wherever similar conditions exist, care should be taken to differentiate between the compulsory and the voluntary members.

We must not think that the difficulties and inaccuracies of the statistics would be lessened if we included not only those whose illness necessitated suspension of work, but all the sick. The difficulties would be different, it is true, but they would by no means be fewer. The number of those who ask for medical aid—and these would all have to be included in the statistics—is always dependent upon the most varied outside influences. It is influenced somewhat by the cultural standard of the workman's group but it depends largely upon the ease with which medical aid can be obtained. If there is a physician in the factory, or near the factory, who may be easily consulted during working hours, many employees who are paid by the hour will seek his advice for slight illnesses. If a loss of wages is involved, however, either because the employee is paid on a piece-rate basis or because he has to go outside the factory in order to see the physician and consequently has to be away from work several hours, the physician is rarely consulted, and the number of cases treated is limited. Here, too, many sources of error are present.

Finally if we wish to discover the influence of a trade on the condition of health from the statistics of the sickness insurance companies, we must always remember that a certain amount of selection of occupation takes place—that there are trades which the delicate enter, and others which the strong enter; and that as a result the sickness frequency in these trades varies considerably.

Value of Sickness Statistics

From the points which have been brought out in the foregoing discussion, we see that the statistics of the sickness insurance companies can give us much interesting material —only material, however, not established truths. Like all such figures, sickness insurance statistics only indicate in what direction investigation is necessary in order to discover the true conditions and the means for their improvement. They do not exempt us from the effort to discover, through further research, the true conditions, which are always too complicated to be tabulated. We may determine statistically, for example, that in a certain region the profit on landed property is small. We should first ascertain whether this is due to the poor quality of the soil or to unsuitable cultivation, and then should make further investigations to discover how the income from the property can be increased.

In order to supply useful information, sickness statistics must be worked out properly in accordance with a suitable and uniform plan, for uniformity alone makes comparison possible. It is obvious that no statistics can indicate a solution for all the special questions that arise; separate problems require special study. It is important, however, that the general facts be given in such a way that they may be used for the study of special problems.

Mortality Statistics

The mortality statistics of the sickness insurance companies are wholly unsuited to use in mortality studies. The insurance companies pay sickness insurance and eventually death insurance but only within a certain period after the beginning of the illness. The German sickness insurance companies are obliged to pay sickness money for twenty-six weeks (the period may be lengthened to fifty-two weeks) but only under certain circumstances do they pay death insurance after this period. Owing to this limitation, some of the deaths from chronic diseases escape record, but deaths from acute diseases are, of course, recorded in the insurance statistics. I was able to prove that when the Printers' Sickness Insurance Company of Vienna made sickness and death payments during a period of twenty-six weeks, in 21 per cent. of the cases death occurred after the expiration of the period and consequently was not recorded; and that when payments were made for a period of fifty-two weeks, 11.1 per cent. of the deaths were unrecorded. Statistics which are so incomplete are of little use, even for purposes of comparison; for whether or not a patient who has a chronic disease outlives the period of twenty-six or fifty-two weeks depends essentially upon the progress of the disease at the time when it is reported. Men doing heavy work usually have to stop working in a much earlier stage of tuberculosis than do office clerks. Therefore there is a considerably higher percentage of deaths from tuberculosis recorded for the clerks than for men doing heavy work.

It is unfortunate that these facts are often, indeed almost always, overlooked. In an explanatory text accompanying one part of its statistics, the Leipzig Local Sickness Insurance Company carefully points out the fact that owing to this source of error its mortality figures for the most unfavorably situated workers in most of the age groups appear more favorable than, for example, the mortality figures for physicians according to the material of the life insurance companies. In interpreting other parts of the statistics, however, the company itself has forgotten this deficiency.

Although we can make little use of the mortality statistics of the sickness insurance companies, excepting those for certain acute diseases, we obtain from them other material which is of value.

Age Distribution in Various Occupations

Thorough researches have shown that the distribution of ages is quite different in the various trades and occupations. The German industrial census of 1907 and the extensive researches of the German industrial inspectors in 1912 show us that there is a relatively small number of old workers in the mining industry, and a relatively large number in the textile industry. In determining the distribution, all ages, from 14 to 60 and over, were included. For our purpose, all the workers under 20 years of age should be eliminated, because the percentage of such

workers to be found in any industry depends chiefly upon how much demand there is in that particular industry for children from 14 to 16 years old—that is, for unskilled and weak workers. In many industries, for example, in the glass foundries, there are large numbers of children who do not intend to remain but who can get good employment there during their youth.

If we limit ourselves to the workers over 20 years of age, we find that, according to the above-mentioned investigations, the percentage of workers over 50 years of age employed in various industries is as follows:

Collieries in the vicinity of Dortmund	3.36
Production of cast iron	9.90
Steel works	12.50
Chemical industries	14.20
Textile industries	20.00

It would be entirely wrong to take it for granted that those who have left an industry because of their age are dead or total invalids. The figures simply show us that industrial incapacity appears early in some industries, and late in others; and that the workers in certain industries are forced to give up their accustomed occupation early and to seek new work. There are, of course, various reasons which may lead workers to leave the wage-earning group of an industry. In every trade which can be practised on a small scale—for example, hair dressing—most of the workers leave the wage-earning group while young in order to set up independent enterprises. Moreover, there are some industries—such as the automobile industry and the rubber industry, which is partially dependent upon it—which have not had the time to collect a group of old workers because of their short existence, and because at the start they naturally employed young persons who would adapt themselves to new methods of work. All these factors must be taken into consideration, when the figures for these industries are under observation. Like the sickness insurance statistics, these figures present only material for our study, not established truths.

Up to the present time such figures have always been the result of large scale investigations. It must be emphasized that figures for individual establishments are misleading, since the ages of the persons employed depend largely upon the policy of the managers. We must therefore make an effort to acquire our information with regard to age distribution not from a particular factory but from as many factories as possible, or from all similar establishments within a specified industry. If the insurance statistics record all the trades in the way which I have outlined, and arrange the members according to age groups, we can obtain an insight into the age distribution of employees in many trades, and eventually in every branch of industry. The larger the number of workers recorded, professional and industrial, the more reliable will be the final results, which will give us further insight into the demands made by particular occupations upon individuals, and into the rapidity of the consumption of the workers' strength.

Summary and Conclusions

From the foregoing discussion we see how much material on the effect of occupation on health can be obtained from insurance statistics which have been carefully compiled—material, that is, building stones for our study, not finished truths. The statistics are not an end in themselves; they do not exempt us from the efforts of further and more thorough research; on the contrary, they force us to make further investigations, if we wish to discover the truth. But they are a real help in our study which we should do our utmost to develop.

In order to obtain useful statistics a slow educational work must be undertaken for insurance company managers, insurance employees, and insurance physicians. The compilers of our death statistics should also educate their co-workers and arouse their interest. The more able we are to refer to practical results developing from the statistics the greater will be the increase in interest. The sickness insurance statistics should be utilized to the utmost. The insurance managers themselves should use them for the improvement of their own business, and for the improvement of every deficiency of the insurance company's organization. They should also be studied by employers and particularly by industrial inspectors and supervisors so that they may put through hygienic and technical reforms. The interest in insurance statistics of those concerned as well as of the general public will be aroused and stimulated only by such practical results.

J. I. H.
March, 1924